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NAVIGATION

OF THE

Pacific Ocean,

ILLUSTRATED BY CHARTS,

BEING A BRIEF ACCOUNT OF THE

WINDS, WEATHER, AND CURRENTS

PREVAILING THEREIN THROUGHOUT THE YEAR

COLLECTED FROM THE MOST APPROVED AUTHORITIES,
INCLUDING EXTENSIVE EXTRACTS FROM
THE NAUTICAL MAGAZINE

BY

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PREFACE.

THE following pages, reprinted from those of the *Nautical Magazine*, contain a collection of information on the winds, weather, and currents of the Pacific Ocean, that will be found of much assistance in its Navigation. Like those of the *Atlantic and Indian Oceans*, to which they form a companion, they are founded on the compilation of Captain Kerhallet of the French Imperial Navy, interspersed with additions from fresh sources of information, published since the appearance of his work. As the commencement, in a collected form, of that kind of information only which they contain, they must be so received. Yet their Compiler, aware that much is still wanted in yet unfrequented parts of this Ocean, looks to the same valuable source for their future gradual improvement, as that from whence they are obtained,—namely, the intelligent and observant Seaman, who is the authority always for these matters, and who thus contributes to the prosperity of his country by pointing out to his brother seamen the best road for the intercourse of nations.

London, April, 1860.

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A.
GENERAL VIEW
OF THE
WINDS AND WEATHER
OF THE
PACIFIC OCEAN
THROUGHOUT THE YEAR.

[It has been observed in most parts of the world that bad weather and gales occur more frequently about the time of the new rather than that of the full moon, and that it blows more in dark cloudy nights than when there is clear moonlight. It is by considering her position in reference to her apogee and perigee when she is near one of the phases above mentioned that the following law has been established concerning the changes which may occur at the time, principally in the Indian Ocean:—

When the moon approaches her perigee there is much chance of a change of weather.

If the new moon occurs at the time of her perigee the chances are still greater of a change of weather, or about 100 to 3.

When the new moon occurs at the time of her apogee the chances of a change of weather are 7 to 1.

When a full moon coincides with her perigee the chances of a change are 10 to 1; and if with her apogee the chances are 8 to 1.

When the new moon coincides with her perigee and the sun is on the equator there is much chance of a change of weather; and when the foregoing circumstances are combined at the period of the autumnal equinox a typhoon on the South coast of China and other places within the tropics may be expected.

It should be remembered that these changes do not occur precisely at the epochs above mentioned, that they may take place two or three days after the change of the moon; and she is in her apogee when her semidiameter and her horizontal parallax are the least possible, and in her perigee when, on the contrary, these quantities are greatest.]

General Winds.—This vast expanse of ocean, bounded on one side by Asia, the Philippine Islands, and New Holland, and on the other by the western coast of America, extends from the Arctic to the Antarctic circle, over a space of 133 degrees of latitude. It was unknown to Europeans until the year 1513, and was first seen by Vasco Nunez de Balboa, from the summit of one of the mountains of the isthmus of Panama.

Magalhaens, more generally known by the name of Magellan, crossed this sea from America to the Philippines, and named it the Pacific Ocean, in consequence of the constant fine weather that he met with during his voyage.

The Pacific Ocean, to which perhaps the name of the Great Ocean might have been more applicable, is the largest sea of our globe. It is less occupied by land than any other, and in general we only find in it small islands, either singly or in groups.

On considering the outline of its coasts, we find these widely apart in the southern portion of it, a feature, which it preserves as far northward as the tropic of Cancer, near which circle only the coasts of Asia and America converge previous to uniting at Behring Strait, in the latitude of 65° North.

The formation of the coasts of the Pacific Ocean resembles in several remarkable features those of the Atlantic. The Western coast of South America projects much in the same manner as that of the same coast of Africa to the South of the equator. The gulf of Panama and the coast of Mexico are situated like the gulf of Guinea and the promontory of Africa. The Carribbean Sea, which engulfs itself in the eastern coast of Mexico, assimilates to that between the North coast of Australia and the coast of China, in which we find the Molucca and the Philippine Islands, &c. Nevertheless, these two seas in their other parts, whether North or South of the line, differ much in the contour of their shores.

The Pacific Ocean is commonly divided into two parts by the equator; but to facilitate our consideration of it, we shall divide it into three parts, viz., first, being the most important, the equatorial Pacific Ocean, shall be comprised between the tropics; secondly, the North Pacific, will be bounded by Behring Straits and the tropic of Cancer; thirdly, the South Pacific, will be comprehended between the tropic of Capricorn and the Antarctic circle.

Equatorial Pacific Trade Winds.—It was formerly considered that throughout the space occupied by the Pacific Ocean the trade winds blew with as much and even more regularity than in the Atlantic Ocean. But numerous recent observations have shown that probably not one half of this sea is subject to the influence of the trade wind, and we are all but assured that the S.E. trade wind only blows over that portion comprised between the meridian of the Gallapagos (150 or 200 leagues from the coast of America) and the meridian of the Marquesas, or Archipelago of Nouka-Hiva; and that the N.E. trade wind, which, commencing at about 100 leagues from the coast of America, extends to about the neighbourhood of the Marianne Islands.

Deviation in the Trade Wind.—The numerous groups of islands

Westward of the islands of Nouka-Hiva, and near the Australian coast, as well as those situated North of the equator in the same latitude, appear to effect a modification of the trade winds of the Western Pacific into periodical winds or monsoons, and also variable winds. Thus we find that in these groups, in the zone situated North of the equator, the trade wind only prevails from October to May; from March to October in that situated South of the equator, and that Westerly winds, storms, and rain occur during the rest of the year. We shall refer again to this important fact, and adduce some undoubted proofs of this from amongst numerous observations in the voyages of circumnavigators.

Zone of the Trade Winds.—The zone in which the trade winds of the Pacific prevail, where, as above observed, they blow with regularity, is comprised between the equator and the parallels of 30° North and 30° South latitude.

On consulting a large number of authorities, we have constructed the following table from voyages in the Pacific Ocean of ninety-two vessels which have crossed the equator between the meridians of 106° and of 147° West longitude. Incomplete as it is, it yet shows some important facts, although they should only be considered as approximations, having been deduced but from comparatively few observations.

The following table shows the limits of the trade winds every month, and the breadth of the zone of the variables of the equator.

Month.	Polar Limits of the Trade Winds.		Equatorial Limits of the Trade Winds.		Breadth of the Zone of the Variables North of the Equator.
	From N.E. Lat. N.	From S.E. Lat. S.	From N.E. Lat. N.	From S.E. Lat. N.	
	° ′	° ′	° ′	° ′	° ′
January	21 0	33 25	6 30	3 0	3 30
Febuary	26 28	28 51	4 1	2 0	2 1
March	29 0	31 10	8 15	5 50	2 25
April	30 0	27 25	4 45	2 0	2 45
May	29 5	28 24	7 52	3 36	4 16
June	27 41	25 0	9 58	2 30	7 28
July	31 43	25 28	12 5	5 4	7 1
August	29 30	24 18	15 0	2 30	12 30
September ..	24 20	24 51	13 56	8 11	5 45
October	26 6	23 27	12 20	3 32	8 48
November ...	25 0	28 39	”	”	..
December ...	24 0	22 30	5 12	1 56	3 16

Polar Limit of the Trade Winds.—From this table it is evident that the polar limits of the trade winds are variable, and that they are found most to the Northward and Southward according as the sun has a North or South declination.

Equatorial Limit of the Trade Winds.—It is also evident that the equatorial limits of the trade winds is equally variable, according to by the western coast of America, extends from the Arctic to the Antarctic circle, over a space of 133 degrees of latitude. It was unknown to Europeans until the year 1513, and was first seen by Vasco Nunez de Balboa, from the summit of one of the mountains of the isthmus of Panama.

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Month.	Polar Limits of the Trade Winds.		Equatorial Limits of the Trade Winds.		Breadth of the Zone of the Variables North of the Equator.
	From N.E. Lat. N.	From S.E. Lat. S.	From N.E. Lat. N.	From S.E. Lat. N.	
January	21° 0′	33° 25′	6° 30′	3° 0′	3° 30′
Febuary	26 28	28 51	4 1	2 0	2 1
March	29 0	31 10	8 15	5 50	2 25
April	30 0	27 25	4 45	2 0	2 45
May	29 5	28 24	7 52	3 36	4 16
June	27 41	25 0	9 58	2 30	7 28
July	31 43	25 28	12 5	5 4	7 1
August	29 30	24 18	15 0	2 30	12 30
September	24 20	24 51	13 56	8 11	5 45
October	26 6	23 27	12 20	3 32	8 48
November	25 0	28 39	”	”	”
December	24 0	22 30	5 12	1 56	3 16

Polar Limit of the Trade Winds.—From this table it is evident that the polar limits of the trade winds are variable, and that they are found most to the Northward and Southward according as the sun has a North or South declination.

Equatorial Limit of the Trade Winds.—It is also evident that the equatorial limits of the trade winds is equally variable, according to the season, and leads to the conclusion that the zone of the variable winds, which separates these limits, is not so broad in the winter as in the summer of the Northern hemisphere.

Zone of the Variable Winds of the Equator.—It shows also that the equatorial zone of the variables moves as much to the North of this circle as far as the results can do which we have collected. This zone also assimilates much with that of the Atlantic Ocean. It is larger on the meridians of 90° to 100° than on those further to the West, as 120° to 130° of West longitude. Hence the breadth of the zone decreases in proportion as it is Westward. There in fact calms and light airs, varying from N.W. to South by the West, are found, and frequently stormy weather.

The Northern limit of this zone is about the parallel of 8° North latitude. Its Southern limit is in 3° N. Nevertheless it sometimes happens that the N.E. and S.E. trade winds reach each other, and vessels pass from one to the other without experiencing calms.

The S.E. Trade.—Between the parallels of 30° S. and 4° S. lat., at 150 or 200 leagues off the coast of America, bad weather is not generally found. The trade wind, varying between East and S.E., blows constantly to the middle of this zone. In the summer the direction of the wind varies from E.S.E. to S.S.E., and never veers Northward. When the sun is in the Northern hemisphere, the trade winds of the Southern hemisphere blow directly from the S.S.E., and on the contrary they blow more from the East when the sun is in the Southern hemisphere.

In examining the foregoing table we see that the polar limit of the S.E. trade seldom attains the parallel of 30° South latitude. Its equatorial limit, on the contrary, often reaches to the North of the equator, as already observed. The result is, that the zone of the S.E. trade wind is generally larger than that of the N.E. The S.E. trade winds are more certain and less variable than those of the N.E. In the zone occupied by the former, calms and storms are much less frequent; lastly, we may observe, that in this zone the temperature has been found lower than in that of the N.E. trade, a fact which is confirmed by observations collected during recent voyages.

N.E. Trade.—The foregoing table, compared with that drawn up for the Atlantic Ocean, proves a fact asserted long ago, that the polar limit of the N.E. trade winds of the Pacific Ocean is nearly the same as that of the same wind in the Atlantic Ocean; at least it differs from it very little.

In the northern hemisphere, when the sun has North declination, the N.E. trade comes more directly from the East, but varies to E.N.E. and sometimes to the southward of it, but accompanied then by squally weather.

On the contrary, when the sun is in the southern hemisphere, the trade wind takes a more northerly direction, varying from E.N.E. even to N.N.E. In this case the equatorial limit of these winds approaches nearer to the equator than in any other season, but it never passes to the South of this circle.

The N.E. trade wind is always constant, and blows fresh towards the middle of the zone above-mentioned from October to May, and it extends to the Philippine islands. In which season a ship crossing the Pacific from the Eastward should keep between the parallels of 13° and 14° North latitude.

The N.E. trades are, however, generally less constant, and therefore less to be depended on than the S.E. trades. In their variations they sometimes come from the South, as already observed, and they blow as frequently from E.S.E. Calms and storms are also more frequent in the zone where they are found than in that of the S.E. trades.

Monsoons of the Pacific Ocean in the Zone of the Trade Winds.—It has been shown above that the S.E. trade winds are only regularly established in the space comprised between the eastern meridian of the Galapagos and that of the Nouka-Hiva group, and the N.E. trades in that which commencing at 100 leagues from the coast of America, extends to the Marianne islands. But in adducing this fact as a general law, it is not pretended that it is so in every part of it in the same manner, and precisely the same time.

We have said that to the North of the equator the N.E. trade wind blows over the whole of the Pacific Ocean from October to May, or nearly so; and South of the equator the S.E. trade wind blows from March to October, although we often find variations among the islands situated South of the equator.

We have added that these winds are replaced in the West part of the Pacific Ocean, during the rest of the year by variable winds or monsoons, contrary to the opinion which has been long established in this respect, and the following justifies our remark.

The Pomoutou and Nouka-Hiva Groups.—In the month of July, 1838, the corvette *Astrolabe,* in the latitude of the Pomoutou group, met with the S.E. trade wind in 19° 50′ South latitude. From the 15th of July, the time when she was in this latitude, and in 114° W. longitude, to the 28th of July, she experienced less regular winds, varying from N.N.E. to S.S.E., most often light, and intersected by winds from N.W. to S.W.b.W., blowing fresh.

From the 28th of July to the 5th of August, being in sight of the islands of Manga Reva, she experienced nine days of N.W. wind, varying to S.W. by the West, the N.W. wind bringing strong breezes with fine weather in general, although cloudy. To the 15th of August the prevailing winds were those from N.W. to S.S.W., the weather cloudy and sometimes rainy. The winds from W.S.W. were the strongest. These winds were interrupted by light breezes from N.N.E. to S.E.b.E.

From the 15th of August to the 20th of the same month, the period when the *Astrolabe* was in sight of the island of Clermont Tonnerre, she had the same variable winds that she experienced in the archipelago of Nouka-Hiva. At the end of August and the beginning of September winds varying from W.N.W. to S.S.W. by the West.

M. Duperrey, in the same latitudes, experienced in April South winds varying from West to W.N.W. by the West. It thus appears by these observations that near these two archipelagos the S.E. trade wind is not the most frequent. They also confirm this remark of Cook, to the effect that, in the neighbourhood of islands the trade is not a regular wind, and that it does not extend beyond the parallel of 20° S.; that further South in these latitudes the winds blow from the West, and the trade wind is hemmed into so narrow a space that it blows with greater violence. Near these limits the trade wind is much lighter.

In the archipelago of Nouka Hiva, Krusenstern also mentions S.W. winds, which are tolerably constant.

Tahiti Group.—In the Tahiti Group the winds during part of the year vary from E.S.E., E.N.E., and sometimes (especially in July) East to S.S.E. The trade wind blows strongly in this archipelago; the weather is then cloudy and we sometimes have rain. In October, November, December, and part of January the winds blow from West to S.W. They are interrupted by calms and light breezes from the East and sometimes by storms and rain. In December and January, when the sun is in these latitudes, the wind and weather are very changeable. It is then that moderate winds from W.N.W. to N.W. last five or six days. With these winds the sky is cloudy, often with rain. If they pass to the North they are much slackened and replaced by winds from W.S.W. to S.W. If they take a more southerly direction they become strong. The S.W. and W.S.W. winds are more frequent than those from the North.

A second but all important observation presents itself in the circumstance that this archipelago is very close to that part of the Pacific Ocean where the trade winds are regularly established throughout the year.

We might adduce a similar observation in respect of the Tonga or Friendly Islands. In September we find S.E. winds there, followed in October by S.W. to S.S.W. winds, and even by those from N.N.W. The same observation has been made in regard to New Caledonia. In December, 1838, the *Astrolabe* experienced, near the Solomon Islands, winds from W.S.W. to S.S.W., sometimes blowing very strong, with cloudy and rainy weather.

Solomon Islands.—Among the Solomon Islands the N.W. monsoon commences in December or January. Sometimes these two months are tolerably fine. In February and March fresh breezes, with heavy squalls and abundance of rain, may be expected. April is generally a fine month. The winds are then variable until May; during which the weather is often fine.

In June the S.E. monsoon is very strong, with frequent rain squalls; and bad weather, interrupted by a series of fine days, lasts until the end of August. In September the monsoon begins to slacken, and from this time to the return of the N.W. monsoon the breezes are moderate.

Eastward of these islands the N.W. monsoon is not so constant. It commences later, towards the end of January, and blows fresh during sixteen or eighteen days, when it is followed by the wind from East, which blows during the same number of days. The West wind then sets in with a little bad weather and continues, with storms and rain, constantly blowing hard. These winds from East and West last alternately until the end of March, the time when the regular S.E. winds commence. The further to the East the more irregular is the N.W. monsoon, and it is not found beyond the Nouka Hiva Group.

New Britain and New Ireland.—At New Britain and at New Ireland the S.E. trade wind is found to prevail only from March to October. When the sun has South declination the West winds, varying from N.W. to S.W., replace it during the rest of the year.

New Guinea.—At New Guinea two monsoons are found, which seem to be the continuation of those from the China Sea. One is the N.W., the other the S.E. The S.E. monsoon prevails from the middle of May or June until October; that from N.W. from November until May. In December we generally find the wind varying from N.N.W. to N.E.

Eastward of New Guinea the wind is from the S.E. during the time that the S.W. monsoon is blowing North of the line.

Torres Strait.—In Torres Strait the N.W. monsoon commences towards the end of October and lasts till the middle of March. The S.E. trade blows in April and strengthens till June, being sometimes very strong in this latter month and also in July; they then slacken and gradually moderate.

Marianne Isles.—In the Marianne Islands we find a monsoon from West, beginning from the middle of June and continuing to the middle of October. The rainy season lasts during the months of July and August, but often only known by a succession of heavy showers. During the westerly monsoon the wind varies very much to the time of the syzygies, and then blows hard from all points of the compass. The typhoons and hurricanes met with in the China Sea occur in the latitude of these islands at the time of the changes of the monsoons. The East limit of these storms is near their meridian. From the 15th of October to the 15th of June the weather is fine and the Easterly monsoon prevails throughout this interval.

From these facts, which if we were to quote more of them would oblige us to exceed our general observations, it appears that with regard to the S.E. trade winds the zone where they in a manner permanently prevail is bounded on the West by the meridian of the Nouka Hiva Group, and that with regard to the N.E. winds the zone where they blow without interruption does not extend to the West of the Marianne Islands.

Some further general observations on the monsoons are added here: That from the West in the Pacific, as in the Indian, Ocean is generally accompanied by a cloudy sky, squalls, and heavy rains; and sometimes the squalls are so violent that all sail must be taken in, even when the wind is aft. They are generally heralded by a strong W.S.W. wind which lasts about an hour, and, shifting to N.W., continues to blow very strong for five or six hours more.

Hurricanes of the South Pacific Ocean.—In the Pacific Ocean, between the parallel of lat. 10° S. and the tropic of Capricorn, hurricanes occur principally from November to April, and this is another particular in which this sea assimilates to the Indian Ocean. Hurricanes are more frequent in the latitudes of the New Hebrides and New Caledonia than anywhere else. They are often met with near the islands of Viti and Tonga. Generally speaking, where the S.W. monsoon extends we meet with hurricanes, or, rather, the S.W. monsoon and hurricanes are found within the same meridians, without reference to any limit in latitude. In fact, while the S.W. monsoon scarcely attains the parallel of lat. 13° S., and rarely passes those of 17° or 18°, the hurricane extends as far as the tropic.

The hurricanes of the Pacific are not so terrific as those of the Indian or Atlantic Oceans. They are more frequent and violent near the islands than off the coasts. In the South Pacific, however, they are rare, and several years pass without one.

The hurricanes of the southern hemisphere, like those of the Indian Ocean, have a giratory movement in the same direction as the hands of a watch, and also a general progressive motion on a line like a parabolic curve, the bend of which is in about lat. 26° S., and such that a North and South line is a tangent to it, the curve being open towards the East, the line of track next to the equator being directed towards the S.W., while that furthest from it points towards the S.E.

Regular Storms of the South Pacific Ocean.—Near the Tonga Islands, and perhaps in other parts of the zone of which we are speaking, very violent squalls are met sometimes, and always blowing in the same direction. Their effects are nearly as bad as those of hurricanes, and are peculiar to the southern hemisphere.

Storms in the North Pacific Ocean.—The Marianne Islands are sometimes desolated by hurricanes. In the months of June, July, August, December, and January they are the most frequent. These hurricanes sometimes occur further to the East, and Captain Hunter mentions one experienced by him in 1882, in the ship *Japan*, on the parallel of lat. 13° N. and long. 150° W., about the meridian of the Sandwich Islands.

In the zone of the South Pacific Ocean, where, as observed, the S.E. trade winds are constant, not a single hurricane has been yet noticed. But in the same zone where the N.E. trade blows they are sometimes met with. These facts confirm our observation on this trade that it is less regular and less certain than the S.E. trade, as squalls and storms are more frequent in the zone which it occupies than in that of the S.E. trade.

Several remarks still present themselves on the strong winds that are found East of the Sandwich Islands, in the zone of the N.E. trade and near its northern limit. The *Superb*, on her way from Valparaiso to San Francisco, was, on the 16th of September, in lat. 15° N. and long. 120° 10′ W.. The wind was light from N.N.E., but squalls were very heavy, with rain. At 4h. p.m. the weather assumed a more threatening appearance, and as night came on the wind increased.

At 11h. p.m. it suddenly attained such violence that the after sails were got in with much difficulty. For an hour the most vivid lightning filled the whole horizon, succeeded by deafening thunder. The storm only lasted five hours, when the wind abated and, shifting to South, became moderate. The next day at noon the weather was quite serene, and the breeze moderate from East.

On the 3rd October, 1854, the brig *Giffard*, in lat. 25° 32′ N. and long. 140° W., had a fresh breeze from N.E., the weather cloudy and gloomy. A heavy bank of clouds was observed in the East. The barometer varied from 29·70 to 29·80. At midnight the breeze freshened with sudden gusts, accompanied by rain. The *Giffard* was steering N.W.b.W. On the 4th October the wind became stronger and rain heavier. At noon they were in the latitude of 27° 40′ N. and long. 136° 30′ W. The barometer 29·60; at one o'clock it had fallen to 29·35, and the wind increased at the same time that the rain became incessant. The Captain, conjecturing that they were gradually entering a typhoon or a rotatory storm—the wind being from E.S.E. and they steering W.N.W., which showed that the ship was in the North part of the zone occupied by the hurricane,—decided on laying to to let the storm pass. The wind being from East he laid her head N.N.E. At four in the afternoon the barometer marked 29·30; at midnight, 29·25, the wind still blowing from E.S.E.

On the 5th October the wind was very violent and the rain incessant. They continued to steer for the cape. At 4h. a.m. the barometer was at 29·20, the wind, S.E.; 8h. a.m., bar. 29·15, wind S.S.E.; noon, bar. 29·05, wind S.S.E.; 2h. p.m., bar. 29·00, wind S.b.E. The wind then attained an excessive degree of violence, the rain was incessant and the sea a sheet of foam. At 4h. p.m., bar. 28·80, wind South; 8h. p.m., bar. 28·70, wind S.S.W.

At this time the ship was struck by a sea on her starboard side so severely that with the combined effect of the sea and wind, which had attained its greatest force, she was partly dismasted and lay on her port side. At midnight the barometer was 28·70, and the wind unabated in force.

On the 6th October, at eleven o'clock, the barometer began to rise. At 2h. it was 28·90, wind W.S.W. and moderated a little. The rain still fell incessantly. At 4h. a.m. bar. 29·00, wind S.b.W.; 8h. a.m., bar. 29·10, wind S.b.W.; noon, bar. 29·30, wind West.

The wind at this time had moderated, although blowing at intervals in strong gusts. The opinion of Captain Briard, of the *Giffard*, was that the storm was moving towards the N.W., but on the 5th it took a more northerly direction, as the wind was more violent when the focus of the storm bore N.W.

The *Giffard* was skilfully managed, and, especially on the 4th and 5th, was near that part of the storm where, after travelling from East to West, it curved towards the North, to follow its N.E. course.

This observation is important because we know very little of the hurricanes of the Pacific Ocean.

In concluding our observations on the zone of the trade winds in the Pacific, some remarks appear necessary on the climate of the Sandwich Islands, and particularly an abstract of those made by the learned Dr. Rooke on the winds of the year 1837, and parts of 1838 and 1839, at Honolulu. This place is very important from its solitary position in the midst of the Pacific Ocean and its vicinity to the polar limit of the N.E. trade.

The climate of these islands much resembles that of the Antilles. The N.E. trade winds generally prevail there. In December the thermometer falls to 72°; in August and September it rises to 80°; the mean temperature for 1838 was 77°. Cook says that in December the summits of the mountains are covered with snow. Towards the end of November and December the land breezes blow for several days and then abundance of rain falls. In 1838 the quantity of rain measured was 12·6 inches.

From December to March, in the interior, the rains are more abundant than in the Antilles all the time, yet the weather is fine on the coast. The wind is constantly then between E.S.E. and North, varying a short time a few points to the northward and southward. During these same months the land and sea breezes succeed without interruption day and night.

These islands, unlike the Antilles, are free from winter or stormy season with hard gales.

The following table is deduced from Dr. Rooke's observations:—

Year.	Days of Trade Wind.	Days of Southrly Winds.	Days of Variable Winds.	Fine Days.	Days of Changbl. Weather.	Remarks.
1837	295	44	26	285	43	March winds most variable.
1838 Jan. to June	137	24	20			Ditto.
1839 Jan. to July	159	38	15	168	20	Jan. winds most variable.

North Pacific Ocean.—The region that we have named the North Pacific Ocean is comprised, as already said, between Behring Strait and the tropic of Cancer. Two zones must be recognized in this region—the temperate and the frigid zones, and we will now refer to the temperate zone.

Temperate Zone.—In the temperate zone of the North Pacific Ocean, comprised between the parallel of 50° N. lat. and that of 30°, the wind in all the seasons blows from every quarter. It is observed, however, that from the month of May to October, that is during the summer months, the prevailing winds are from West to S.W.; and that from November to April the prevailing winds are from West to N.W. Thus in the course of the year West winds, varying from N.W. to S.W. are the prevailing winds of this zone.

Some navigators still assert that from the coasts of Asia to the middle of Behring Strait the winds are generally from W.S.W., and that they become W.N.W. and N.W. in the eastern part of this strait. However this may be, we find an incontestible proof of the prevalence of West winds in this zone in the voyages from Manila to Acapulco, made every year at the same time by the Spanish galleons. These vessels sailed regularly from the Philippines in the month of July, taking the route between the parallels of 34° and 37° N.,—their passage being from ninety to a hundred days over a space of 2,400 leagues.

Further to the northward, on the parallel of 40° N., N.E. gales are common. However, Anson said that between this last parallel and that of 50° N., during the summer months westerly winds are more regular than between those of 30° and 40°, and much more so than the trade winds in the adjoining zone. The winds to which we are alluding assume nothing of the characters of monsoons, but blow at any period. The S.E. winds blow also very frequently during the winter. Sometimes N.W. winds mostly prevail during the summer.

In this region S.E. winds in all seasons are always accompanied by bad weather, rain, or fog. N.W. winds, on the contrary, bring fine weather, generally dry and fresh. With the wind from W.S.W., the weather is generally gloomy and rainy. The winds from South to East are in general very hard; and with the wind at East on the N.W. coast of America, for instance, it often freshens up to a gale; during which it changes to E.S.E. and S.E., hauling round to West, but bringing fine weather.

Frigid Zone.—The frigid zone of the North Pacific Ocean, has been little visited and the remarks consequently are few. Northward of the parallel of 60° N. the breadth of the ocean diminishes rapidly and it terminates in a basin of small extent. It is only during the fine season that these latitudes have been explored. In Behring Strait the wind is generally either from North or South, at once accounted for by the formation of the coast, for in all straits bounded on both sides by elevated ground the current of the wind generally assumes the direction of the channel.

South of this strait the winds are very variable, and it has been found that southerly winds were the most frequent. These variations are easily explained. The basin of this sea is inclosed by two continents, the mountains of which are always covered with snow. and therefore it must be subject to constant changes of temperature, which necessarily act on the currents of air. Observations nevertheless prove that South and S.W. winds prevail about the Aleutian Islands. We shall return to this subject in referring to the prevailing winds along the coast of the Pacific Ocean as we make the tour of this great sea.

The region that we have considered the South Pacific Ocean extends from the tropic of Capricorn to the Antarctic circle. Let us divide this, like the former, into two zones: the one temperate, from the tropic to the parallel of 50° S., the other the frigid, between the last parallel and the antarctic circle.

In the temperate zone of the South Pacific Ocean, the winds, during all seasons, blow from every quarter. Nevertheless, in this region, as in the corresponding one of the Northern Pacific, the prevailing winds are those from West, varying to N.W. and S.W. These winds sometimes extend to the tropic, and reach as far as the parallel of 20° S. principally in the western part of the Pacific Ocean. The westerly winds, varying to N.W., prevail during the summer; and those from West to W.S.W. and S.W. during the winter. The N.W. winds are generally fresh and sometimes very strong. The S.W. winds shift suddenly to the southward and blow quite as strongly, bringing rain. Sometimes, again, we find easterly winds, varying to S.E. and becoming steady, especially in June and July.

N.W. winds, even when they blow hard, are accompanied by fine weather. The rule, however, is subject to exceptions, particularly near the islands of this region. In their neighbourhood S.W. and S.E. winds are found; the former violent and accompanied by rain, the latter in general moderate but yet with rain. Thus, in the vicinity of New Zealand, where N.W. winds prevail, they sometimes bring storms, particularly in February; in March and April the weather is very rainy; in May, westerly winds with rain; in October, strong breezes from South; and in November N.W. winds prevail, accompanied by squalls.

In the frigid zone, which can only be explored during the summer, it is not easy to say which are the prevailing winds. From November to March N.W. winds were those that Cook principally found between the parallels of 35° and 67° S. But in his exploration of the antarctic regions he tarried long in the temperate region just alluded to. His observation therefore is not conclusive. He remarks that in November and December he had no stormy weather, nor any strong wind.

In the voyage to the South Pole made by the *Astrolabe*, under the command of Admiral Dumont D'Urville, we find that during the time she was near the parallel of 60° S. the winds varied much during the months of December and January in the following proportion:—Westerly winds, varying from W.N.W. to S.S.W., twelve days; easterly winds, varying from N.E. to S.S.E., twelve days; winds from South to S.S.W., two days. The S.E. winds are those that bring stormy weather, and generally these winds are very strong. The others were moderate, except those from N.E., which were also strong.

To the northward of the parallel of 60° S., the prevailing winds were principally from West, varying from N.W. to S.W., during the time that the *Astrolabe* was in these latitudes, in January, February, and March 1838 and in December and January 1840. In the two surveys of these regions that were made in 1839 and 1840 by the

American Captain Wilkes, the following tabular statement of the winds was made:—North winds, seven days; South winds, five days; East winds, varying from N.E. to S.E., thirty-eight days; West winds, varying from N.W. to S.W., forty days. These observations were made in the months of January, February, March, and April.

To the observations of Admiral Dumont D'Urville and Captain Wilkes we may add those of Sir James Ross, who went as far in the frigid zone of the Pacific Ocean as the meridian of 160° 15′ W., and to the parallel of 77° 49′ S. These observations comprise an interval of three months and seventeen days. December, 1841:—East winds, varying from N.N.E. to S.S.E., twelve days; West winds, two days; North winds, two days; only light or moderate breezes. January, 1842:—Easterly or N.N.E. to S.S.E. fifteen and a half days; westerly or N.N.W. to S.S.W. twelve and a half days; South winds, two days; North winds, one day. Squalls from N.W., one day; strong breezes from South, two days; the others fresh or moderate. February:—Easterly or N.N.E. to S.S.E., fourteen days; westerly or N.N.W. to S.S.W., eleven and a half days; North winds, two days; South winds half a day. Strong breezes from N.N.E. half a day; fresh breezes from S.W., one day; the others fresh or moderate. March:—Easterly or N.N.E. to S.S.E., five days; westerly or N.N.W. to S.S.W., twenty and a half days; North winds, one day; South winds four and a half days. Strong breezes from N.N.E., half a day; fresh breezes from S.W., one day; the other winds strong and fresh, sometimes moderate.

These observations point to the conclusion that in the frigid zone of the South Pacific Ocean, during the summer, the East and West winds blow in nearly equal proportion, but it must not be forgotten that as yet very few observations have been made.

To complete our view of the winds of the Pacific Ocean it remains for us to add the observations made on those blowing along the coasts—winds that are very important to navigation; and thus, although generalizing as much as possible, it will be still necessary to go into details in certain localities. We will commence with the western coast of America.

South Shetland Islands.—The most dangerous winds in the South Shetland Group are those from East, which blow with great violence and are accompanied by snow. In 1820—22, four-fifths of the squalls in these islands were from East. In the fine weather the N.E. and S.W. winds were about equal, remaining steady but a short time. The S.W. winds brought a clear sky, they dispersed fogs or snow that came with N.W. winds. Squalls from N.W. are rare, but are sometimes very heavy. Robert Fildes says that land winds are very rare, and I have observed that these winds are generally light and accompanied by cloudy weather. He also says that in doubling Cape Horn from the eastward, on finding contrary winds, instead of beating to windward with whatever sail can be carried, a ship should stand to the southward and will be certain of soon finding easterly winds, with which she may make westing enough to double the Cape, or at least to take her into S.W. winds and clear to the westward of Terra del Fuego.

Winds in the Latitude of Cape Horn.—Near Cape Horn westerly winds prevail during the greater part of the year. Those from the eastward only blow during winter months, when they are sometimes very strong, but they are rarely to be found during the summer. December, January, and February, which are the summer months, have some fine days, but the westerly winds which then prevail are heavy and attended by much rain. March is the worst month of the year, as the equinoxial months generally are throughout the world, and brings tempestuous weather, but without so much rain as in the summer months. April, May, and June are the finest months, although then the weather is sometimes disturbed by breezes. In these months the East winds are most frequent, attended with fine weather. June and July are much alike, but in July easterly winds are most frequent. August, September, and October are nearly the worst months in the year, excepting March; westerly winds prevail, nearly always blowing hard, and accompanied by rain, snow, and perhaps cold, frosty weather. The following observations supply the character of these winds.

Those from North always commence with a moderate breeze and gloomy weather, the sky is overcast, and the wind East. These northerly winds are generally accompanied by slight rain. In proportion as they freshen, they gradually take a westerly direction, and blow with great force between North and N.W. The sky is then laden with heavy clouds, the weather dark and gloomy, and rain falls in great abundance. When the violence of the westerly wind is over, which is after an interval of twelve or fifteen hours—and even then it may be blowing fresh from this quarter,—the wind changes to S.W. and blows with as much force as before. This wind drives away all clouds, and a few hours after it has commenced the weather becomes quite clear, with occasional squalls. This S W. wind lasts generally for several days, blowing hard, but it then moderates and is followed by two or three days of fine weather.

Northerly winds are those of summer, and it always happens that these northerly winds shift to the southward by westerly winds during this season, which would not merit the name of summer if the days were not longer and the temperature somewhat higher than at any other time of year. At this season the rains are heavier and the winds stronger than in the winter. Easterly winds are always light and bring fine weather as soon as they set in; but as they gradually increase in force, the weather becomes cloudy. They gradually go down, sometimes after having blown strong, and at other times they suddenly change and blow from another quarter. It has been observed that bad weather never comes on suddenly from the eastward, and that S.W. and South winds never shift suddenly to northward; but southerly and S.W. winds, on the contrary, get up on a sudden and blow hard.

We have just observed that southerly and S.W. winds get up suddenly and blow hard. This is therefore a circumstance which deserves attention in order to be prepared for them at all times.

These squally southerly and S.W. winds are indicated by thick white clouds; the edges of which are well defined and themselves large and massive. Before northerly and N.W. winds the clouds are low, the sky is dark and other clouds appear at a higher elevation, and the sun being scarcely seen through them assumes a reddish appearance. For some hours, even sometimes a day, before a North or West wind an observation of the sun cannot be had, although it may be visible, the mist in the upper part of the atmosphere preventing the edge of the disc from being seen. Sometimes with a light breeze varying from N.N.W. to N.N.E. there may be some days of fine weather. These winds are then succeeded by southerly winds and abundance of rain.

The prevailing character of the weather in these latitudes is a fresh N.W. wind, varying to S.W., at the same time the sky being cloudy. Thunder and lightning seldom occur in these parts, The seaman is warned of the heavy squalls from South and S.W. by large masses of clouds, and frequently by snow or large hailstones, rendering them still more formidable.

Lastly, it has been observed that on the western coast of the promontory of Cape Horn southerly winds prevail, while at the same time at sea off the pitch of the cape the wind is from West. This remark equally applies to the Cape of Good Hope and Cape Van Diemen.

Winds in the Strait of Magellan.—What we have just said with regard to the winds near Cape Horn may be also applied to all the Magellan lands. Westerly winds prevail during the greater part of the year at the entrance of Magellan Strait in the Pacific. They are particularly strong in March, so much so at times as to become stormy. They bring rain and sometimes snow, and a very high sea According to many navigators westerly winds prevail chiefly during summer on the whole of the Magellan coasts, and also during the greater part of the year,—namely, from July to March. In the winter they are sometimes interrupted by easterly winds, which last some time and bring fine weather.

In December, January, and February these westerly winds vary from N.W. to S.W. and sometimes blow fresh. In March, as already stated, the weather is always bad. In April the prevailing winds are from E.N.E. to E.S.E., interrupted by occasional fresh westerly breezes. In the strait, as in all narrow channels, the wind is very variable. According to Anson, the most favourable month to pass it from East to West is December, because, he says, that at this period the winds are generally moderate, especially in the first part of the month.

Periodical Winds or Monsoqns on the Coast of Chili.—It has been long considered that the winds along the West coast of America, from the Strait of Magellan to Panama, had almost always a constant tendency to blow from the southward to the northward, with modifications according to the formation of the coast. But this rule, although applying to a certain extent of coast, does not reach the coast of Chili.

On this coast there are two monsoons, which, although not so regular as those of the Indian Ocean, are nevertheless well established. Thus, northerly and N.W. winds prevail there in winter, that is from May to September; and from the middle of September to May southerly and S.E. winds are found, sometimes blowing very hard. The northerly and southerly names by which we here distinguish the monsoons are intended to signify the directions that the winds blow most frequently from, inclining more or less to the eastward or westward, and therefore it might be better to designate these winds by the name of alternate periodical winds than by that of monsoon.

The bad season lasts from the end of May to September. During these three months calms and light breezes are found with occasional West and S.W. winds and very bad weather. In the commencement and throughout this season also northerly gales, with much rain, are experienced not only near the coast but also for some distance out at sea. The gales, however, are not very violent.

The fine season lasts from September to May, that is for about nine months. The sky is then generally clear, and comparatively little rain falls. In the summer, however, although not often strong, northerly winds are occasionally found, and now and then two or three days of constant heavy rain. These changes in the fine season are neither so common nor so severe to the northward of the parallel of 31° S. lat. as they are to the southward of it.

A fresh southerly breeze generally gets up a little before noon (an hour, or perhaps less) and lasts till sunset, sometimes even till midnight. In the middle of summer it sometimes blows so fresh as to prevent vessels from reaching a harbour. Valparaiso, amongst other harbours, sometimes cannot be gained in spite of every care being taken to do so. The ordinary strength of this sea breeze (which, although it blows along the coast, is so termed) is such that even well-found vessels are frequently obliged, if working to windward, to double-reef.

It is the same with the southerly wind off the coast between the parallels of 35° and 25° S. lat., although this is not so strong in the offing during the day as near the coast, and it does not go down at night. In the offing the wind is fresher, but it is little felt in the harbours, where it is mostly calm at night until an easterly wind rises. This is a light breeze from the Cordilleras, quite harmless and lasting only for a few hours, and nearly always with a clear sky. In the summer time, when attended with fog, it is a sure indication of there being no wind at sea, besides showing the probability of rain. In winter when the sky is overcast it foretells of northerly wind and rain.

On the coast of Chili, as in the whole of the southern hemisphere, the course of the winter winds is from North changing to Westward. The strongest winds and those which bring the worst sea, are those from West of North. A vessel when anchoring ought, therefore, as much as possible to seek shelter from points which project Westward, and not under those which only shelter them from northerly winds. In summer vessels anchor near the land, so as not to be blown out to sea by southerly winds. In winter it is necessary to keep further off it (without being too far,) for near the coast the wind is not so strong, and advantage may always be taken of the lull which prevails there.

Northerly Winds.—The Northers, as they are called, are generally well characterised; the sky is very overcast, there is little or no wind except from East, the swell comes from the Northward, the tide is stronger than usual, the neighbouring land is remarkably distinct and elevated by refraction, and the falling of the barometer are some of the surest indications of these winds. Northerly winds are not always squally, and sometimes several years pass without any that deserve that character. Nevertheless it is seldom that many pass without several vessels being cast away by them.

Thunder and lightning are rare; and on the coast of Chili we never find an Easterly wind so strong as to distress shipping. Westerly winds are only felt when the northerly wind changes before the sky clears, and the wind becomes less. The Northers never last longer than a day and night, and generally not so long.

The strength of the Southerly winds is only for a few hours. Some seamen are of opinion that the Northers are not felt North of Coquimbo. There are, however, numerous instances of squalls and heavy seas at Copiapo.

Chiloé.—At Chiloé it rains constantly during the whole year, and the Southerly monsoon lasts longer there than at Valparaiso.

Valdivia.—At Valdivia Westerly winds are frequent and very strong.

La Concepcion, Valparaiso.—At Concepcion the periodical winds above mentioned are as well established as at Valparaiso. At this latter place the winter and its Northers frequently do not set in until the middle of May, and last till September, gradually losing force. But sometimes northerly winds blow strong from the month of April. The northerly monsoon lasts about four months.

The fine or dry season, accompanied by southerly winds, succeeds the northerly winds and lasts till May. These winds, varying from S.W. to S.E.b.S. are sometimes very fresh, and ships at Valparaiso often drag their anchors. The monsoons abovementioned reach to seventy or eighty leagues out at sea.

Coquimbo.—Off the coast about Coquimbo, the Northerly Monsoon only lasts for three months. In the course of the night theland breeze sets in, probably about midnight, and falls a short time after sun-rise. The climate here is so uniform that it has been named La Serena.

Copiapo.—At Copiapo strong N. W. winds are occasionally met with, and the periodical winds of the coast of Chili are not found to the Northward of this place. On the coast of Chili tornados are unknown, nor are they anywhere met with on the coast of Peru.

General Winds on the Coast of Bolivia and Peru.—On the coast of Bolivia, from Copiapo to Cape San Francisco, in 1° North lat.

Southerly winds prevail throughout the year, varying from S.S.E. to S.S.W., with a sky always overcast. These winds seldom exceed a fresh breeze, and on certain portions of the coast are often scarcely strong enough to enable a vessel to sail from one port to another. This is especially the case between Cobija and Callao.

Occasionally in the summer two or three consecutive days of calm take place with a perfectly clear sky. On those days when the sea breeze sets in, it generally commences towards ten o'clock in the morning; it comes at first light and variable, and keeps gradually increasing till one or two o'clock in the afternoon, and then continues well established till sun-set, when it begins to slacken. Soon after sun-set there is a dead calm, and towards eight or nine o'clock in the evening a light land breeze gets up and lasts till sun-rise. At this time there is a dead calm, which continues until the sea breeze again sets in. The land breeze varies from N.W. to N.N.E. and even to E.S.E. The sea breeze varies from S.S.W. to S.W., and sometimes even to W.S.W. These winds are then very similar to the solar breezes. During the winter season, from April to August, light north winds may be expected, generally accompanied with thick fogs, and a cloudy sky. This condition of weather is not common in summer, although the summits of the mountains are enveloped in mist.

North of Callao the wind may be expected with more certainty. Here the sea breeze is found very regular, attaining more strength than anywhere to the Southward. On the coast of Peru about Payta, and off Cape Blanco, the sea breeze is often so strong as to oblige ships to double reef.

It is observed that notwithstanding the wind on the coast of Peru is generally moderate, heavy breezes come down from the mountains even after the sea breeze is established. They are found very detrimental on entering harbour if not provided against by shortening sail considerably.

The only difference in the prevailing winds in winter and summer here is the frequency of light North winds during the winter. The difference of climate is however greater than one would suppose, for so low a latitude. In summer the weather is superb, with the thermometer rarely under 70° and often above 80°, while in winter the weather is cold and damp, with thick fogs and a cloudy sky, when it is necessary for the health of the ship's crew to adopt flannel.

The general winds of the coast of Peru extend about 500 miles to sea, from whence they take a more Easterly direction, so that at 600 miles from the coast the S.E. trade is generally found. Sometimes, especially between Chili and Callao, the wind veers to W.S.W. reaching 90 or 120 miles out to sea, and blowing fresh at the distance of 15 or 20 leagues. On this coast there is generally a fog in the morning, and heavy dews during the night.

Between Pisco and Callao the wind varies from S.S.W. to S.E. Between Callao and Guayaquil southerly winds change to S.W. between November and May, and during the summer is W.S.W.

At Lima it is said that it never rains—certainly not such rain as is found within the tropics is to be found there, but sufficient to wet one through has been experienced by the author. The sky is generally overcast. From March to September the weather is fine; in summer storms occur; and in October thick fogs are experienced.

At Callao those storms are not found that are frequent on the coast to the southward of it. The winds from North to N.N.W., so scarce at Callao, are good breezes. Those from West to N.N.W. are but weak when they do come. During summer the wind is generally from S.W. to W.S.W., and in winter from South, changing sometimes to S.E.

At Payta and near Cape Blanco northerly winds are not met, but instead of them southerly breezes, rarely becoming S.E. One naturally concludes, when navigating from the northward to the southward, that in working up near the coast, in order to profit by the variable winds, great difficulties will be met with; but this is by no means the case. The land wind is generally weak near the shore, and calms often prevail off the most prominent points. Another source of difficulty in this passage is the current, setting always to the North or N.W., that prevails there. However, M. Humboldt asserts that the Spanish vessels proceed along the coast in going from Guayaquil to Lima because in these regions, he says, the land breeze blows for eighteen hours and the sea breeze only six hours; consequently, a vessel may sail S.S.W. with the land breeze and stand near the coast with a sea breeze. In these latitudes a vessel should not be further from the coast than fifty or seventy leagues. This way of sailing, called by the Spaniards *por el meridian*, has the advantage of enabling a vessel to avoid the squalls of wind which are often met with in August, September, October, and November, between the parallels of lat. 28° and 33° S., in keeping to sea when crossing the zone of the trade winds, and not standing in for the land until the vessel is sufficiently to windward to attain her port.

At the Galapagos, in November, December, and January, stormy and squally weather prevails. During May, June, July, and August, the weather is fine.

Between Cape San Francisco and Cape Corrientes, from September to March, the wind is from North, varying to N.E., when it changes and continues between S.E. and S.W. during the rest of the year. Thus vessels from Peru and Guayaquil to Panama may take advantage of these winds in going and the northerly winds in returning. On this portion of the coast, from June to November heavy squalls are encountered, as well as frequent calms. Near the Island of Gorgona it rains nearly all the year round, but more especially in June, July, and August.

In the Bay of Panama the winds winds vary from East to North from September to March, and from South to S.S.W. during the rest of the year. The dry season is that in which the wind prevails from E.N.E., and lasts from December till April or May, the months in which the rainy season sets in with squalls; the rain gradually increases, and is heaviest in June, July, and August; in September it lessens, and terminates in November or at the latest in December.

In the Bay of Panama alternate land and sea breezes are found. The former blow from S.S.W., the latter from North, varying to N.N.E. These breezes are only regular during the dry season; they are very light during the damp season, and cease entirely with the rains. Mr. J. H. Smith, a gentleman long resident in Panama, gives the following general view of the weather at that place, which is entitled to attention:—

January, February, and March.—Fresh North winds, fine weather, and clear sky.

April.—North winds decreasing, with frequent calms, and light southerly airs in the day. Latter end of this month, occasional squalls from the North in the afternoon, with rain, thunder, and lightning.

May.—During the day frequent calms and light southerly winds, weather becoming cloudy, and occasional fresh squalls from N.E. to S.E., with rain.

June.—The rainy season well set in, breezes during the day increasing from the South, with squalls and heavy rain; nights generally clear, with light land breezes from the North. Latter end of this month eight or ten days of fine weather frequently occur.

July, August, and September.—Moderate South winds, squalls and rain. During the equinox four to six days of strong South winds, without cessation during the night, and frequent squalls, with rain.

October.—South winds, squalls, and rain. Frequent land winds at night, and fine West.

November.—South winds decreasing, with frequent intervals of fine weather, and occasional squalls off the land.

December.—First part of this month, frequent calms and light South winds during the day. Latter part, occasional North winds and fine weather.

The rainy season in Panama is not so severe as in some parts of India—seldom a continuance of rain for more than twenty-four or thirty-six hours.

When the North or South winds continue fresh during the day and night at Panama they always blow strong at the entrance of the bay. With the South wind a long swell sets in, causing a heavy surf on the reef on the South side of the town.

The anchorage in Panama Bay may be considered secure; the ground is mud and holds well. During my residence in Panama (near five years) I have never known a vessel to be driven from her anchor; in fact, with good ground tackle, and common precaution, a vessel may lie there all the year round with one anchor down.

The rainy season 1852 was unusually severe, and the rains continued until the 5th of February of the year following, an occurrence seldom known before.

The city of Panama is so situated that two or three hours after heavy rain—which, at the time, will flood the places and streets—the inhabitants are enabled to walk in any part; and it only requires proper sewerage to keep it cleanly all the year round.

Periodical Winds on the Coast of Mexico or Lower California.—From the western extremity of the Bay of Panama to the parallel of lat. 30° N., we find the periodical winds on the coast of Mexico called monsoons. On this coast, from November to April the wind varies northwardly from N.W. to N.E.; and from May to October it varies from S.W. to S.E. These winds, however, do not blow with the regularity of the monsoons of the Indian Ocean. These Mexican monsoons extend forty or fifty leagues from the coast, but at seventy leagues from it the N.E. trade wind is generally found.

On this coast, between lat. 10° and 20° N., westerly and W.N.W. winds sometimes are found as well as tornadoes and weather like that of the corresponding western coast of Africa—that is, calms during the night and, towards morning, light land breezes, lasting until about eight o'clock.

The winds which prevail between S.S.W. and S.S.E. from May to October are called by the Spaniards *vendavales*, and are accompanied by heavy rains, tornadoes, calms—often lasting several days, with continual thunder and lightning. Sometimes the rain continues incessantly between three and four weeks.

The squalls generally come from S.W. from July to October. They are called *tapayaguas* on the coasts of Nicaragua and Guatemala. It is dangerous work to seek Mexican ports at this time, and the Spaniards never think of going to San Blas or Acapulco before the end of November, when this weather is gone by. Some seamen aver that fine weather cannot be looked for with certainty until the month of January.

Winds from N.W. to N.E., as already observed, prevail during the winter—from November to April, inclusive—when the weather on the coast of Mexico is fine. The Spaniards call this season the summer of the South sea. However, while it lasts strong N.N.E. and N.E. winds are frequent, with a clear sky. They are called *papagayos*, and M. Humboldt says that they extend from the Gulf of California to the Bay of Panama, that is from lat. 22° N. to 7° N., and are more severe in about 10° N. In May, June, and July, these winds continue from the northward for three or four days together, and often for a whole week, without ceasing.

Between the parallels of lat. 13° and 15° N. long calms are found, especially in February and March, like those in the Gulf of Guinea. Cases are on record where they have lasted for twenty-six days, and this too at a distance of eighty leagues from the coast.

About Acapulco, during the winter, the wind is West and often strong from N.W. At this season vessels must be cautious not to approach the land to the southward of their port, and must keep far enough to the northward to admit of nearing the shore with the N.W. wind, on account of the current which sets S.E. along the land. The only thing in favour of keeping in shore southward of Acapulco is that of profiting by the land breeze, which, although light, blows all night from East to E.N.E., and lasts till eight or nine in the morning.

In the winter months, as before said, the wind varies between N.E. and N.W. about Cape Corrientes and Cape San Lucar, but not always attended with fine weather as in higher latitudes. Northerly winds generally prevail in November. Sometimes, however, at the end of September and October, off these headlands the wind is found between N.N.E. and N.N.W., changing to West as the coast is approached, bringing rain and squalls.

Prevailing Winds on the Coast of Upper California.—On the coast of Upper California South of Cape Mendocino, N.W. winds prevail without intermission during the summer, that is from May to November. In November, S.W. winds, varying to S.E., prevail, accompanied with rain, but when they veer to N.W. the weather becomes fine. In the month of October, on this coast, a dry scorching East wind, of no long duration, occurs sometimes, resembling the sirocco. In March and April the wind is variable, and in winter, as well as in summer, fogs are very frequent on this coast.

North of Cape Mendocino, according to Vancouver and the Spanish navigators, the weather is generally bad and stormy, and subject to heavy squalls from S.E. South of this cape the wind is generally moderate and the weather fine. In the winter Krusenstern says that southerly winds are generally moderate near this cape.

Alternate Land and Sea Breezes on the Coast of Upper California.—On some parts of the coast of Upper California near Monterey, and between this place and the parallel of 30° N. lat., alternate land and sea breezes are found. The land breeze blows at night from East, varying from N.N.E. to S.S.E.; the sea breeze lasts during the day, blowing lightly from N.W. to N.N.W.

Prevailing Winds on the N.W. Coast of America.—On the N.W. coast of America, from Cape Mendocino to Cooks Gulf, in 60° N. lat., the winds are variable. Most navigators, however, agree that the prevailing winds are West, varying from S.W. to N.W., with foggy weather. In general the weather is fine with the wind at N.W., and becomes cloudy and rainy when it changes to S.W. During the summer, from Cape Mendocino to 57° N. lat., near the coast the prevailing winds are from N.N.W. to N.W., sometimes interrupted by light S.W. winds, producing fog and rain. Should the wind haul from West to South and continue to shift Eastward, it is generally the forerunner of a storm, and the return of the wind to West brings fine weather.

North of Cape Mendocino, during winter and spring, S.W. winds prevail, and with some force.

The preceding observations on the winds of the coast of Central America, between Cape San Francisco and Cooks Gulf, agree closely with those of Lieut. Wood, Commander of H.M.S. *Pandora*, who was four years in the Pacific Ocean, principally on this part of the coast. It may be as well to give these as we find them from Lieut.

Wood, that they may be compared with the preceding. Besides, they form a complete view of the winds of the central and N.W. coasts of America:—

"On the coast comprised between the River Guayaquil and Point Guascames, during the whole year the wind is chiefly from South to West. The exceptions are not many and are only found during the fine season. In two cases, when sailing in a southerly direction near this coast, the first time in May and June, and afterwards in October, November, and January, we have met with winds varying from S.S.E. to W.b.S., with a current setting N.E. The only difference we observed was that the winds were lighter and the weather finer in May and June in proportion as we advanced South, while the contrary was the case in October, November, and January.

"After entering the Bay of Choco, the southern point of which is Guascames, the winds were more variable; however, during the time we were there (from the end of January to the middle of March) they were never strong, although the weather was often uncertain and it often rained heavily. The S.W. were the prevailing winds and those from N.W. very rare.

"After passing Point Chirambira, the northern point of the Bay of Choco, the wind veered more to the North, and towards the end of March, we were obliged to beat against strong N.W. and N.E. winds as we approached the bay to reach the Bay of Panama.

"On this latter part of the coast, in January, 1848, the winds were more variable. Heavy rains generally accompanied their change when they veered to S.W., from which quarter they were once or twice very strong.

"Between the South point of the Gulf of San Miguel and the Gulf Dulee, including the Bay of Panama and the coast of Veragua, the winds are dependent on the seasons. Towards the end of December northerly winds set in. They are pretty strong, but with no rain, generally beginning in the afternoon and lasting till midnight, and very fresh from N.N.E. to N.N.W. With these winds the weather is perfectly clear, the sky cloudless, the air so dry and rarefied that objects on the horizon are altered or lowered, and the same effects are observed as on the European coasts with an easterly wind.

"Although these winds generally blow so strong as to oblige ships to double-reef, they are sometimes much more violent, especially off the coast of Veragua, where in January and February they blow so severely as to oblige them to close-reef. And in the midst of their strength sometimes they drop and a dead calm ensues at from ten to fifteen miles from the coast. The only indication we have of the wind existing a little way off the ship is the agitation of the sea, which rises in short deep waves, dashing over the deck and causing the ship much violent and uneasy motion.

"Towards the end of March or middle of April these northerly winds begin to fail, and are followed by calms and alternate land and sea breezes. Sometimes these calms and winds are interrupted by occasional squalls from S.W. As the month of April advances they become stronger and more frequent, and in the beginning of May the rainy season is generally well established.

"During the greater part of this season the prevailing winds are from South, varying to S.W. They are not very strong in the Bay of Panama but in a westerly direction from Point Mala the gusts of wind from these quarters are frequent and violent and, while they last, produce a very heavy sea.

"From the Gulf of Dulce, proceeding westward, along the coasts of Costa Rica, Guatemala, and Mexico, the winds are found varying with the seasons, although slightly modified by the locality. Thus, for example, wherever northerly winds prevail we find that they blow in an almost perpendicular direction to that of the coast. Thus, as we approach the coast of Nicaragua (which takes a more northerly direction than those just mentioned) in the fine season we find the northerly winds changed into breezes termed *Papagayos.* They blow from N.N.E. to E.N.E. and East. Like the northerly winds, they are accompanied by fine clear weather. The prevailing winds of this season (the dry season), which lasts from January to April, vary from S.E. to N.E. From May to November, which is the rainy season, the weather is very bad; subject to squalls from West and S.W., accompanied by violent storms, which are very frequent.

"From the Gulf of Fonseca to the Gulf of Tehuantepec, a part where the coast assumes nearly a W.N.W. direction, we do not meet with northerly winds until we reach this latter gulf, where we again fall in with them, under a different name and with a more violent character.

"Along that portion of the coast where the chain of mountains descends to the shore and in some places forms it, the winds during the fine season (from January to April) are generally alternate, the usual tropical land and sea breezes; the former blowing from N.W., the latter from South, varying to W.S.W. and West. The other months of the year are distinguished by bad stormy weather and winds from the same quarters as on the coasts of Nicaragua, namely from West and S.W.

"The heavy winds across the Isthmus of Tehuantepec are caused by the nature of the country over which they pass. They seem to originate from the northerly winds which blow in the Gulf of Mexico from September to March, and which find a passage between the chains of mountains of Mexico and Guatemala. They are very severe and come from the North, varying to N.N.E., and produce a short heavy sea. They are found still strong some hundreds of miles from the land. In the dry season, when they prevail, (from December to April,) the rigging should be well set up, in order to preserve the masts, and great attention paid to the sails; and with these usual precautions a ship may cross the region where they prevail in safety, according to circumstances, for 200 or 250 miles East or West. If, on the contrary, a vessel is obliged to lay to, an interval—from a day and a half to five or six days—of bad weather, with a short heavy sea, may be expected. These breezes are called *Tehuantepecs.*

"In the rainy season the Tehuantepec ceases to be felt, and at this period (from April to September) the weather becomes very bad, which is the case on all the coast of Mexico. Squalls and heavy winds, varying from S.E. to S.W.b.S., and also violent storms with incessant rain, are always found there at this season.

"The storms are sometimes very heavy and render the navigation on this coast very difficult, as there is hardly a single place of refuge from them to be found.

"During the dry season, on the contrary, no where is weather so uniformly fine and uninterrupted as on this coast of Mexico. The sea breeze commences every day about noon, beginning at S.S.W., varying to W.S.W., and, veering further West, decreases as the sun goes down, falling calm at sunset; after which the calm continues until it is interrupted by the land breeze, which is less regular both in force and direction. These winds and the manner of profiting by them in sailing westward along this coast, have been so well treated of by Dampier and Basil Hall that nothing remains for me but to confirm their remarks on this head.

"When the coast again trends northward, which is the case near Point Texupan, northerly winds are again found, blowing from the Gulf of California. These winds are very fresh a few miles from the coast during the fine season. A vessel taking advantage of these winds, and of the daily variations in their direction caused by the alternate land and sea breezes, may cross rapidly from Point Texupan to the ports of San Blas or Mazatlan. It is, however, always difficult to work to windward against a lee current and frequent calms.

"From Cape St. Lucas to Cape San Diego the wind is generally between West and North. In the winter, that is from November to April, this coast is exposed to strong breezes from S.E., which a ship must be prepared for when at anchor, most of the bays being open to that quarter. On the North part of this coast they are still more severe, but off Cape St. Lucas are less frequent. They generally give notice of their approach long before they come. The only way to make a passage from any port of this coast to the northward is to stand out to sea on the starboard tack; as the offing is gained the wind will be more from the eastward and thus the zone of the variable winds may be gained, from whence, on the other tack, the ship will gain her destined port. In summer time the only difference in these variables is that there is more westing in them in the mornings, following the course of the sun as the day advances.

"From San Diego to San Francisco the prevailing winds during the whole year are N.W. This coast of Upper California, like that of Lower California, is subject to sudden winds from S.E. They are more frequent and stronger also on the coast of Upper California than on the former. Nearly all the bays and harbours of this coast are also open to these S.E. winds, with the exception of those of San Diego and San Francisco, which are perfectly sheltered from them. In winter time ships should anchor in all others in positions from which they may get under way easily. Thus, on the first appearance of heavy clouds in the S.E. and a swell from the same quarter (the invariable signs of a South-easter), a ship must quickly get under sail. It will be also advisable to have a spring on the cable to cast the ship as most convenient, and a buoy on it in case of being obliged to slip it, should there not be time to heave up the anchor.

"These breezes last from twelve to forty-eight hours, bringing heavy rain with them, which does not cease till the wind changes. This change sometimes takes place suddenly, the wind blowing as hard as before from N.W. for several hours; after which the sky becomes clear and the fine weather is reestablished.

"Off Point Conception these heavy winds are so frequent that it has obtained the name of the Cape Horn of California. The winds here are generally from North to West, blowing strong, especially in winter, and often lasting three days without a single cloud until they moderate. Another peculiar feature of this coast is the existence of frequent thick fogs during one half of the year, rendering the navigation very difficult to the North of San Diego. The only means of making the land while they last is to verify one's position by the lead, and thus keep tolerably in with the coast during the day, for a very thick fog is frequently found in the offing, while at one or two miles from the land there is a clear horizon and a fine sky. Should this not be the case, when the soundings give notice of being too near the coast, the only way is to stand out to sea and wait for a return of fine weather.

"From San Francisco to Vancouver Island the N.W. are the prevailing winds, and are very constant in June, September, and October. On this coast heavy squalls from all quarters and in all seasons may be expected, especially in winter and at the time of the equinoxes. They generally begin from the S.E. passing southward to S.W. and bringing very rainy weather. After blowing several hours from these quarters, they change abruptly to N.W.b.W., sometimes with no other symptom of this change than an increase of rain. They are then stronger from this quarter than before the change. In the spring the easterly and N.E. winds are more frequent than at any other season; but in the summer the westerly winds prevail, wlth fine weather. However, at the end of July and August the fogs are so frequent and so dense that sometimes for several weeks together a single clear day is not to be seen."

Such are the observations of Lieut. (now Commander) James Wood on that part of the American coast between Guayaquil and Vancouver Island. We have deemed it advisable to give the whole of this remarkable work (which appeared originally in the *Nautical Magazine)* as it is a complete study of the prevailing winds of this coast, now so important from the extent of its commercial relations.

According to observations made at New Archangel, situated in 57° 3′ N. lat., it appears that the prevailing winds in winter are easterly, accompanied by rain and snow. In the beginning of December there are frequent squalls and tempests, which do not occur during the summer. Towards the end of December the aurora borealis is very frequent.

According to the tables given by Lutké from two years' observations—and where unfortunately we find no notice of the winds—in the port of New Archangel, it appears that during the years 1828 and 1829 there were on the average 170 days calm, 132 days of moderate winds, and 63 of strong winds.

By the same account there is, on an average, 74 days fine, 174 rain or snow falling at intervals, and 117 days rain and snow falling continually.

The foregoing are the principal observations we had to make concerning the winds on the N.W. coast of America.

Behring Strait.—As we have already observed, in Behring Strait during the summer the most general winds are from North and South. In that portion of the sea which is bounded on the North by the coast of this strait, on the South by the Aleutian Isles, on the East by the N.W. coast of America, and on the West by the coast of Kamstchatka, generally called in the chart Behring Sea, the winds are very variable, but those which mostly prevail are from the South and S.W.

In Lutké's voyage this is confirmed by a table and statement, including observations three times a day at the establishment at Houlouk (in the island of Ounalaschka), situated in lat. 53° 52′ N., and long. 166° 25′ W.; for one year they give the following results:—

North winds, 92 days.—N.N.W. 49.—N.W. 59.—W.N.W. 32.—West, 85.—W.S.W. 45.—S.W. 106.—S.S.W. 41.—South, 170.—S.S.E. 34.—S.E. 49.—E.S.E. 15.—East, 23.—E.N.E. 6.—N.E. 42. N.N.E. 21.

From the foregoing it is evident that the prevailing winds were South, 170 days; while those from S.W. lasted 106 days.

Passing to the West coast of the basin of the Pacific, and following it from North to South in the consideration of our subject, we may state as a general fact, that on the coast of Kamtschatka Westerly winds prevail during the winter, (that is, from the end of September to May,) and in the summer the prevailing winds are Easterly changing from N.E. to S.E.

In the winter the variable West winds are often attended by violent storms; but in the summer these winds generally bring fine weather. Those from the East, on the contrary, bring cloudy weather, accompanied by snow or rain. In the course of the summer the winds are generally light, and frequently interrupted by calms.

Notwithstanding, Capt. Krusenstern tells us that he does not consider that the Easterly winds prevail on the coast of Kamtschatka during the summer, and mentions those he met there in 1804 and 1805, the following observation on this subject appear conclusive. It is a table of the winds registered at Petropaulowski for the months of May, June, July, and part of September, 1837, by Governor-General Schakof, being an extract from a more extended one that appears in the voyage of the frigate *Venus*, commanded by Adml. du Petit-Thouars.

According to this table, the winds blew on an average from North, 7 days (snow).—N.E. 7.—East, 28 (snow, rain, cloudy weather).—E.S.E. 3.—S.E. 30.—South, 8.—S.W. 7 (fine weather).—West, 5 (clear fine weather).—N.W. 22 (light, interrupted by calms).—N.N.W. 2.—Calms, 19 days.

Thus it appears that the East and S.E. winds were the most general, and their continuance during the time mentioned is evident from these observations. Cook, who was in these latitudes from May to November, mentions the same. In October he speaks of the Westerly winds as being the most general.

Sea of Okhotsk.—In the sea of Okhotsk, according to observations made at the establishment known by this name, during a period of eight years, (prepared by M. Tessan,)—in June, July, and August, the winds were in general from S.E. to East., and seldom from any other quarter. They were moderate winds, and generally accompanied either by rain or fog.

In September, towards sunset, the wind veers gradually from South to the Westward and N.W., and during the night freshens up from this quarter. About 10h. in the morning it moderates, and afterwards changes to South. During the whole of this month the sky is clear and the winds moderate.

From the middle of October to December, heavy storms and gales blow from East or S.E.; fine weather generally follows, when the wind passes to North and N.W.

From December and till the month of April, the wind frequently comes from North to N.E., with a fine sky.

In April and May the winds are moderate, blowing from North during the night, and from South in the day.

It appears also from this register, that at Okhotsk the prevailing winds are Easterly during the whole year, and that Westerly winds are very rare. These observations refer more particularly to the Northern portion of the sea of Okhotsk, of which our knowledge is very limited.

The Japanese Archipelago.—On the coast of Tartary, in the Japanese archipelago, and as far as the island of Formosa, two regular monsoons, of unequal duration, prevail throughout the year. The S.W. monsoon, varying to S.S.W. and South, begins in July and lasts till October. The N.E. monsoon, varying to N.N.E. and North, succeeds it about the end of October and terminates in June.

In the district of these monsoons, throughout all the coasts facing Westward, the rainy eason is that of the S.W. monsoon, while on the contrary it is the dry season on those coasts facing Easterly. When the N.E. monsoon prevails in its turn, the rainy season is set in on those coasts facing Eastward, while on those looking Westward the dry season prevails. These monsoons in the Pacific Ocean reach from the coast out as far as about 140° East longitude.

Near Japan, about the end of August and September strong Westerly winds are sometimes found, and during the S.W. monsoon waterspouts are frequent in those parts.

The typhoons of the Pacific Ocean are found in the same parts, occurring from May to December. The district of these typhoons appears to be bounded on the North by a curved line passing through the middle of the island of Niphon and a little South of the island of Chusan, near the coast of China; on the South by a line drawn midway between Cape Tourane and Cape Padaran, through the North point of the island of Palawan, the North point of Mindanao, Pelew Island, and terminating South of the Caroline Archipelago. The eastern boundary of the same is about the meridian of long. 142° E.; passing to the eastward of the Marianne Archipelago. These limits, however, are by no means constant, and are only given as comprising that space in which the typhoons are met with most commonly.

It has been observed that the typhoons are more violent when they take place in high latitudes. They are common about the time of the change of monsoon, namely in May, June, October, and November. The typhoon generally gives notice of its approach by certain signs, but there is no better method of ascertaining it, so as to take the necessary precautions against it, than the falling of the mercury in the barometer. It is therefore of the greatest importance to observe attentively the changes in the height of the mercury in this excellent instrument—one that very rarely deceives the mariner.

All the islands lying between the coast of China and the North coast of New Holland or Australia, as well as the seas which separate them, are subject to the periodical effects of the monsoons of the Indian Ocean. These monsoons blow from S.W. and S.E. from April to October, and from N.E. and N.W. from October to April.

North of the equator the S.W. monsoon brings the rainy season, and the N.E. monsoon the dry. South of the equator the S.E. monsoon brings the dry season and the N.W. monsoon the rainy one.

Too much precision, however, must not be assigned to the boundaries of the monsoons, neither must the period of their change be considered as certain. The general rule above given is subject to much modification, especially near the islands here referred to; and the period of the change of monsoon is also variable. According to localities, it will take place fifteen or twenty days sooner or later, and there is even one or two months of difference between the China Sea and the islands of the Pacific Ocean.

Island of Formosa.—The channel separating Formosa and China, called the Formosa Channel, lies N.E. and S.W. and appears to be a district of constant gales. During the S.W. monsoon it is visited by heavy rains and severe stormy weather. Between this island and the Philippines gales of wind occur in all seasons.

The Philippine Islands, the Island of Gilolo, and New Guinea form the western limit of that portion of the Pacific Ocean which we are considering.

The monsoons of the Philippines are nearly the same as those of the China Sea. The S.W. monsoon sets in about the end of May on the West coast of these islands, and is in full force towards the month of July. The N.E. monsoon begins in October and lasts till April.

The rains on the West coast prevail from June to the middle of September, during the S.W. monsoon, while on the eastern coast of these islands, during this season, the weather is remarkably fine. During the N.E. monsoon, on the contrary, fine weather prevails on the West coast while heavy rain is falling on the East coast. These rains sometimes last fifteen days without ceasing. The S.W. monsoon, like the N.E., does not blow invariably from those points. The following observations concerning these monsoons appear in an account of a voyage to Cape Horn, Peru, the Philippines, &c.

"On the North and East of the island of Luconia the North winds are sometimes very violent, especially from the beginning of December to the middle of February. These winds are accompanied by rain and stormy weather and cover the land with mist, which renders it difficult to make out and dangerous to approach. In February the northerly winds are generally followed by easterly and N.E. winds, which last till April, with settled fine weather."

According to the same navigator, the S.W. monsoon is subject to similar variations:—"In the Strait of San Bernardino, and especially on the East coast of the island of Luconia, the S.W. monsoon generally blows from between South and S.W., and is frequently interrupted by N.E. winds, varying to S.E. These last prevail over the former as the Island of Luconia is left in approaching the Marianne Islands."

"The monsoons," says M. Legentil, "do not change near the Philippines with such regularity as in the China Sea. Besides which the S.W. winds which prevail at sea are not met with at Manila. They generally blow at intervals of a fortnight or three weeks, and during their cessation other winds prevail, especially those from South and East. These intervals of gusts of wind when accompanied with rain are called *collas.*

"Off the Island of Luconia, from the end of June to the beginning of October, squalls of wind, known in the island by the name of *collas*, are occasionally met with. These are the signs of the storms called *tempestades* and *vaguios.* At sun-rise provious to the approach of the collas the weather is generally fine, the mountains being merely mantled with a slight mist like smoke. In the course of the morning this mist extends over the whole sky, covering it like a transparent veil, which does not quite keep off the sun's rays. At the same time it thickens round the mountains, where it soon forms into clouds. In the afternoon a heavy storm bursts forth, lasting an hour and a half or two hours at most; after which the sky again clears, and the night is extremely fine. These collas, however, sometimes last seven or eight hours, and even extend to fifteen. They generally begin with a squall of rain and wind, and always end in a storm, accompanied by thunder, with heavy rain. The wind then blows strongly from S.W. to N.W., and is sometimes very strong. It takes place at the time of full moon, and always at the times of change. These squalls reach to a great distance, and it is only by them that the winds of the S.W. monsoon penetrate to the Marianne Isles."

The storms to which we have been alluding are known in the Philippines by the name of *tempestades*, a name given by the Spaniards and the Indians call them *vaguios*. In these tempests, which are very severe, the wind blows from all points of the compass with equal violence. They occur chiefly towards the end of July or beginning of August.

In the Philippine Archipelago the change of monsoon is distinguished by storms, as it is in the Indian Ocean; and at Manilla those which take place in October about the time of full moon are especially formidable.

The heat in the Philippines is very great, but the constant dampness of the soil and the alternate land and sea breezes render it less oppressive than one would imagine. Indeed, with the N.E. wind, a certain degree of coolness is experienced. The hottest season is in the middle of March, at the time the East and S.E. winds set in. These winds last about two months, when they are succeeded by those from S.W., called *vendavales*. This transition occasions a great commotion in the atmosphere, producing those tempests above mentioned.

Manila.—Observations made by M. Legentil on the climate of Manila, in the year 1767, are as follow:—

January.—North winds; weather fine, often cloudy, but little rain; ther., min. 64°, max. from 89° to 94°.

February.—N.E. winds; weather fine during the first part of the month, cloudy during the second part, no rain; ther., min. 61° max. 94°.

March.—Wind begins to vary; weather fine, several storms towards the end of the month; ther. from 68° to 103°.

April.—On the 6th wind changes to South and is variable; fine mornings, lightning, several storms and many rainy days during the latter half of this month; heat considerable, ther., at sun-rise, from 76°, at the hottest part of the day, from 103° to 107°.

May.—Variable winds, often from East to South; thunder every evening and rain in torrents; ther., at sun-rise, 79° to 81°, at its max., 101° to 107°.

June.—In the first half of June the wind comes from all points of the compass; few storms, but much lightning. From the 14th to the 19th, E.S.E. and S.E. winds, accompanied by violent storms. During the rest of the month, wind variable, storms seldom, and rain; ther., at sun-rise, from 78° to 82°, at its max., from 99° to 105°,—once it was 108° on the 20th.

July.—During the first half of July East and S.E. winds, and sometimes N.E. The mornings fine, the evenings bad, and the nights magnificent. In general it rains more at Manila in the day than at night. Dnring the rest of the month West winds and no storms. From the 1st to the 15th, the minimum of the thermometer was from 80° to 82°, max. from 100° to 107°; from the 16th to the 31st, min. from 78° to 80°, max. from 100° to 103°. West winds always make the thermometer fall.

August.—During all August the wind varies very much, with storms whenever it is not at West. This month is the worst since the commencement of the year: storms, rain in torrents, and great variation in the temperature. From the 1st to the 20th, the minimum of the thermometer was from 80° to 82°, the max. from 97° to 103°. From the 21st to the 31st the max. is only 85° to 74°.

September.—Westerly winds, but variable; many storms, very little rain; ther., min. from 76° to 79°, max. 97°.

October.—Up to the 20th of October wind very variable and weather much warmer than indicated by the thermometer, which is not higher tha 99°, and generally is from 90° to 96°. Several gales of wind (especially one on the 23rd), accompanied with torrents of rain.

November.—N.E. winds; weather very fine, several cloudy days, but little rain; max. of the thermometer from 92° to 96°,—one day (the 25th) 98°, min. from 73° to 76°.

December.—N.E. winds, with bad weather, up to the 5th; variable from the 6th to the 17th; min. of the thermometer from 71° to 76°; max., the first five days, from 81° to 85°; from the 6th to the 17th, from 92° to 94°,—rainy days, from 83° to 84°; from the 18th to the 31st, from 89° to 92°.

The quantity of rain which falls at Manila is on an average 2·4 in., the max. 2·8 in., the min. 0·4 in.

Periodical Winds of New Guinea.—In alluding to the winds of New Guinea, especially those of the N.E. coast, it was observed that the S.E. trade winds only prevail there from June to October. During the rest of the year, on the N.E. coast, the wind varies from N.W. to N.E. In March, April, and May it is stormy and showery. From June to September there is constant rain on the S.W. coast of this island, and fine weather continues from October to March.

Between New Guinea and Java the monsoons change about six weeks after those of the China Sea.

Waygiou Island.—About this island the wind is generally found moderate from S.S.E. to S.W.

Winds on the East Coast of Australia.—On this coast, from Torres Strait to the tropic of Capricorn, from the end of April to September, the wind is from S.E. The N.W. monsoon blows in October and continues till April. It is also the period of rainy and bad weather; but the S.E. monsoon is the fine season.

Between the tropic of Capricorn and Bass Strait the S.E. wind prevails from October to April, bringing fine weather, with alternate land and sea breezes on the coast. There are, however, some exceptions to this rule, especially towards the South portion of the coast, where squalls from S.W. are met with and fresh winds, shifting from North to N.E., bringing rain, and sometimes thunder and lightning. These winds are generally of short duration. In summer a hot N.W. wind coming from the land is almost always followed by a squall, in which it shifts from S.E. to S.S.W. Vessels on the coast should be prepared for these squalls, which produce a considerable change of temperature. Flinders once found it go down from 101° to 65°.

Westerly winds, varying from N.W. to S.W., and more frequently the latter, begin in May and last till September. These westerly winds while they prevail are generally attended with fine weather, but when they shift to South or East bring rain. The reverse of this takes place during that period when the S.E. winds prevail, and they vary from N.E. to East.

Generally speaking, it may be said that in winter the weather continues unsettled with every wind from the sea, and even with a N.W. or northerly wind. Rain is frequent, although from these quarters it may only be light.

It may be further observed that in summer the land and sea breezes are more regular near the tropics than South of them, and that in winter in these latitudes the wind is more from S.E. than it is between the parallel of 30° N. lat. and Cape Howe. Sometimes also the S.E. monsoon is interrupted by northerly and southerly winds, but these only last a short time.

The following is a summary of the winds at Port Jackson for one year:—

January.—East winds prevail, sometimes light and interrupted by calms, causing storms as they shift to S.W.

February.—East winds, changing to N.E. and S.E., interrupted by N.W. and S.W. winds, veering westward, bringing heavy rains.

March.—S.E. winds prevail, interrupted by southerly winds with rain.

April.—Westerly winds prevail, veering to N.W. and S.W., sometimes blowing strong.

May.—Westerly winds prevail. Same weather as in the month of April.

June.—Westerly winds prevail, varying to S.S.W. and N.N.W., generally moderate, with fine weather.

July.—Same wind and weather as in June.

August.—Same as in the preceding month, with winds from South to East, bringing cloudy weather and rain.

September.—Winds from W.N.W. and W.S.W., interrupted by breezes from East.

October.—East winds, varying from N.E. to S.E.

November.—S.S.E. winds prevail, changing sometimes to South and S.S.W.

December.—E.N.E. and S.S.E. winds prevail, interrupted by winds from S.S.W. and South.

In respect of the changes of the barometer at Port Jackson, it has been observed that whenever the wind is either to the East or West of South the barometer rises, although the weather may continue bad. On the contrary, it falls when the wind is to the East or West of North even when the weather is fine. These observations have been made during June and July. The same has occurred in November and December, but in the unsettled weather of August the barometer rarely does this.

Winds of Bass Strait.—In Bass Strait the prevailing winds are from West and S.W. In summer, from January to March, N.E.

winds are rather frequent and bring clear weather, but their duration is not to be expected.

The same winds and weather are found in Bass Strait as on the South coast of Australia, although in the East part of the strait they assume the character of those of the eastern coast of the continent. In this part of the strait the most violent squalls are from S.E.

In Bass Strait the gales generally begin at N.N.W. and go round to West and S.W., where they generally end. But if before becoming S.W. the wind backs from West to North, a continuance of bad weather is to be expected: otherwise, the barometer is a sure indication of the weather. It is rarely fine when the barometer stands at 29·9 or 30·0, and with the barometer at 20·7 m. bad weather is sure to follow.

Land Winds of Tasmania.—East of this strait, and on the East coast of Tasmania, we often meet with N.E. winds. They rarely blow strong. Squalls come most frequently from S.W. and S.E.,—chiefly from this latter direction, and great caution must be observed in approaching this coast between Capes Howe and Wilson.

On the coasts of Tasmania the prevailing winds are from W.N.W., varying to N.W. These latter are constant, especially from April to the middle of October. From the end of October to March the N.W. winds are interrupted by S.E. winds very frequently, and which sometimes in their turn prevail during this period.

During the year 1834 the wind blew from the following quarters in the following proportion: —

N.W.	93	S.E.	37
North	74	S.W.	29
South	55	West	27
East	37	N.E.	13

NEW ZEALAND.

The following, abridged from the valuable paper by Captain Byron Drury, R.N., of H.M.S. *Pandora*, published by the Meteorological Department of the Board of Trade, gives an account of the winds and weather of New Zealand.

It is a matter of interest to trace the extent of the almost rotatory storm, the N.E. wind, which commences at East, and frequently, after suddenly changing from N.E. to N.W. and S.W., ends within a few points of where it commenced. This is more observable at sea than in the vicinity of the land; where it is an expanded rotary gale, and therefore has not the dire effects of a hurricane. Its prognostics are so certain, and commence so gradually, that the anticipated changes can be made subservient to effecting a passage.

This N.E. gale appears to be common to the southern regions from Bass Strait eastward to Tierra del Fuego. Descriptions of it at the latter place do not materially differ from what is observed here, except that here they are more decided in the spring and summer than in the winter.

Before discussing the local winds of these islands, we may describe the ordinary winds off the coast, extending to Australia and Van Diemen Land, beyond those latitudes where periodical monsoons exist.

The barometer is a certain indicator of changes in these latitudes; no vessel should be without it; but it requires study, for the greater height presages N.E. gales, and its changes require special notice in reference to the weather. In the latitude of Auckland we have known it to range from 30·66 to 28·80 during the revolution of a gale, which began at N.E.

The ordinary wind of these seas is westerly nearly the whole year round.

It may be generally assumed that the barometer falls to North and N.W. winds; that these are the rainy quarters; and that although the wind becomes stronger at first as it draws to S.W., the weather will clear up.

The steadiest wind is about W.S.W. The changes are almost invariably with the sun, or contrary to the movements of the hands of a watch.* South winds bring cold clear weather; and raise the barometer high. S.E. winds are uncommon, but when they do set in, usually in April, May, and June, they last several days; with cold raw weather; and the barometer about 30·00. The N.E. wind occurs about once a month in spring and summer, but less regularly in winter; it is preceded by cloudless serenity and calms; the barometer from 30·30 to 30 60. A light breeze from the eastward, drawing to N.E., is gradually accompanied by a dull sky; the barometer begins to fall and the breeze freshens briskly. The sky becomes overcast, and usually in twelve hours it begins to rain. From that time to thirty-six or forty-eight hours the wind continually increases: in a heavy squall it will suddenly shift to the N.W., from which quarter it blows still stronger for from six to eighteen hours, latterly accompanied by heavy rain or hail; lightning is frequently seen in the S.E. quarter. The barometer is at its lowest a little before there is another (sometimes) sudden change to the S.W., from which quarter it begins to clear, while the glass rises rapidly, although the squalls are at first very violent. The wind sometimes remains in this quarter, sometimes veers round as far as S.S.E.; but if it should remain at W.S.W., fresh steady breezes and fine weather will last for several days. We have traced the diameter of one of these rotary gales to 960 miles.† They seldom last more than three days, before the weather becomes fine.

We now come to the subject more specifically connected with New Zealand, having thus stated a few generalities, and we find it necessary to divide the group into eight portions to distinguish all the local winds.

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* Contrary to those of the northern hemisphere, though still with the sun, which of course is there viewed differently.

† The N.E. gale is a progressive cyclone; not a merely local wind.

The formation of these islands, their comparative breadth at the parallel of the East Cape, with the narrow strip of land to the northward: the Strait, the high snow-capped mountains, and extensive plains and forest tracts, must produce varieties of currents of air; and we find frequent changes, though of short duration. But placed as these islands are, apart from any deserts or icy regions, the ordinary westerly current, unless blowing with unusual force, becomes neutralized by the varied configurations of the country's surface; and for this reason we purpose to divide the islands into eight atmospheric districts, namely:—

1st.—From the North Cape to Mercury Bay on the East coast, and to Kawhia on the West.

2nd.—From Mercury Bay to the East Cape.

3rd.—From the East Cape to Cook Strait.

4th.—From Kawhia to Cape Farewell.

5th.—Cook Strait.

6th.—From Cape Campbell to Cape Saunders.

7th.—From Cape Saunders to Foveaux Strait.

8th.—The West Coast of the Middle Island.

It has been frequently stated that New Zealand is a moist climate as compared to England, but if meteorological data during a number of years be taken as the basis of comparison, it will be found such is not the case. Persons residing in New Zealand during 1851–52, might conclude there was an excess of moisture; but had a person lived in the country in 1853–54 alone, he would come to an opposite conclusion, for the drought then was a source of considerable uneasiness.

Farmers do not complain there of excessive moisture. Indeed, at Auckland no more falls than is required to produce its prolific vegetation, although perhaps too frequent to bring grapes and some other fruits to perfection which thrive in other parts of the colony.

We believe that more rain falls in the West of England and on the West Coast of Scotland and Ireland than in any part of New Zealand.

The comparative absence of great intensity of electricity may modify the falls of rain. It is seldom such floods are heard of as accompany the thunderstorms of other regions. The greatest quantity of rain known to fall in twenty-four hours at Auckland within the three last years was less than at Sydney Heads. We have not been able to trace any accident occurring from lightning.

Fogs are rare, except in the extreme South. In the Bay of Islands and Hokianga there is a morning fog occasionally in September, October, and November, which generally clears up at 10h. a.m., and is followed by a fine day. In the Bay of Plenty we experienced a fog of three days' duration in the month of October, but it was considered quite extraordinary, and they have been experienced in the months of June and July in Hauraki Gulf, but seldom throughout the day.

1.—*From the North Coast of New Zealand to Mercury Bay on the East Coast, and Kafia (or Kawhia) on the West.*

In this division the ordinary wind throughout the year is from N.W. to S.W. on the West coast, and from W.S.W. it lasts longest. In summer the N.W. and S.W. are both fine. In winter the N.W. wind is prevalent, accompanied by rain. When the wind veers South of W.S.W., it blows from the westward off the shore on the East coast, otherwise the wind takes a direction down the coast. There is a sea breeze into Auckland and other harbours on the East coast in summer weather.

N.N.W. winds are accompanied by rain. The N.E. wind, already described, generally ends in a severe gale. S.E. wind is rare, but when it comes lasts several days, with cold, raw weather, sometimes showery.* In winter there are sometimes very sudden changes on the East coast after short intervals of calm. Cloudless serenity in winter is usually followed by a wet day; and a lunar halo is a sure prognostic of rain. The narrow interval between the seas on the West and East coasts and the extensive forests of Manukau conduce to moisture prevailing in Auckland to a greater extent than at the Bay of Islands. It is also for this reason Auckland is milder in winter, frost being uncommon; whereas at the Bay, though a lower latitude, ice may be found an inch thick occasionally.

In the harbours on the West coast the ordinary breezes are from S.W., with land winds in summer, which, however, are very light and partial. In Manukau the West winds are peculiarly fresh, the contour of the coast here forming the apex of an obtuse angle. The harbours on the East coast draw the sea breeze into their various channels in summer. In winter the weather is very variable.

During our experience the maximum temperature in the shade at Auckland in summer was 79°; minimum in winter, 40°; mean in summer, 67°; mean in winter, 52°. And the mean annual fall of rain was 43 inches.

2.—*Mercury Bay to East Cape.*

Between Mercury Bay and the East Cape the summer breezes are from the westward, dying away at night in and near the shore, but not in the Bay. A N.E. gale may be expected once a month, prevailing from March to July. S.E. winds are common near the East Cape, sometimes lasting for several days, and often very strong, but seldom blowing beyond the Mercury Islands. There is also a very strong S.W. gale, which is dangerous in the roadsteads between Cape Runaway and the East Cape; it is preceded by rollers and unsteady flaws of wind.

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* We found on an average of three years, that there were only twenty days with the wind between South and East. They were preceded by S.W. winds, and ended in calm. They occurred in April, May, June, and July. Although S.E. gales are common,—from a degree South of Auckland to the southward—we found only one blow home in the Hauraki Gulf (in June 1852). It lasted forty-eight hours.

The people in sight of White Island can foretell weather by the appearance of the steam from Whakeri: with West winds the smoke is low, and more of it is seen. The S.E. wind, they say, smothers the steam. No doubt the density of the atmosphere tells on that vast body of vapour.

The climate of Mercury Bay may be considered fine, generally.

3.—*From East Cape to Cook Strait.*

Going from East Cape to Cook Strait a very marked phenomenon frequently takes place on rounding the East Cape. The strong westerly wind that drives across the bay carries its line a few miles eastward of the cape, but southward of this the breeze is N.E. Sometimes a vessel may be becalmed for hours between two strong breezes from West and N.E. The configuration of the coast at once accounts for this:—The West wind meets with little obstacle in crossing the narrow and comparatively low land North of the ranges forming the southern boundaries of the Bay of Plenty; at the East Cape it meets the lofty Ikouargi, and the breadth of the country now being considerable; the rarified air over it induces regular sea breezes from the N.E., succeeded in the evenings by the land wind for a short distance from the shore. An exception is the N.E. gale, known on this part of the coast as the black north-easter, to distinguish it from the ordinary sea breeze from the same quarter. In winter the sea breeze cannot be depended upon, and S.E. and South gales set in very suddenly, and even in summer the S.E. winds sometimes last for some days.

In Hawke Bay in spring there are fierce westerly winds for days, with a low barometer and variable weather, ending in a cold South wind, blowing hard for a short time, when the ordinary weather returns.

This part of New Zealand has a fine climate.

The barometer rises for N.E., S.E., and South winds, and falls for North, N.W., and West winds.

4.—*West Coast, from Kawhia to Cape Farewell.*

Along the coast of Taranaki the sea breeze sets in from W.S.W. to S.W., drawing round to S.E. during the day and dying away at sunset.

A N.E. gale produces a northerly swell at Taranaki, greater than when at N.W.

N.W. winds blow very hard for about twelve hours, and then change to W.S.W., afterwards to S.W.

From November to April the weather is fine. In June and July S.E. winds prevail. Gales at any season seldom last more than forty-eight hours. Sometimes a N.W. swell sets in without the wind blowing home. The barometer rises for South and East winds, and falls for northerly, and north-westerly, which is the rainy quarter.

The proportion of N.W. to S.E. winds is about seven to four, which may be assumed as also the proportion of S.W. winds to all others on the West coast.

5.—*Cook Strait.*

In Cook Strait, that is, between Cape Campbell and Stephen Island, it may be said there are only two winds, N.W. and S.E. It is easy to account for the wind coming only from these two points, N.W. or S.E., by the configuration of the Strait, a channel of that direction, bounded by lofty hills on either side; but it is not so easy to establish the causes of the sudden changes with regard to the winds which are blowing outside the Strait. It may, however, be partially accounted for, if we suppose the ordinary ocean wind (W.S.W.) to be represented by the N.W. wind in the Strait until overcome by either of the winds prevalent on the near part of the East coast, namely, the black north-easters, the south-easters, or the South winds; either of these produce a south-easter in the Strait, and when the West wind is very light on the West coast, the N.E. sea breeze of the East coast draws through the Strait, forming the fine S.E. wind. The varied height of the mountains, the snow-capped Kaikoras, the extensive and heated plains must concur to produce great effects on the currents of air. The N.W. wind prevails with fine weather, the S.E. with bad weather: both often blow very violently, and succeed each other suddenly. The appearance of the sky indicates the approach of the south-easter by banking up in that quarter, and by the neighbouring mountains becoming capped with clouds There is also a fine S.E. wind. The finest months are April, August, November, and December. The most windy and rainy are May, June, and July.

Thunder and lightning are unusual.

The following information was obtained from Staff-Surgeon Prendergast, who kept a register at Wellington:—Average fall of rain in 1852, 49 in.; 1853, 67 in.; 1854, 39 in.: mean, 52 in. Maximum amount of rain in one day 2 in. During the same period the barometer (at the sea level) maximum, 30·67; minimum, 28·81: range, 1·86 in.

The following Table of the winds was made from observations at Wellington, in 1854:—

Year.	N.N.E. to N.N.W.	N.W.	S.W.	South.	Calm or Variable.	Gales.
1852	..	225	..	141	..	29
1854	..	221	..	144	..	15

There were fifteen shocks of earthquake in 1852, and twelve in 1854.

The Meteorology of Nelson was observed during eleven years by the late Samuel Stephens, Esq., to whom Captain Drury was indebted for the following information on that subject.

The prevailing winds are:—

January.—N.N.E. to N.N.W. S.E. to N.E.
February.—N.N.E. to N.N.W. S.W. and S.E. to N.E.
March.—N.N.E. to N.N.W. Variable and calms.
April.—N.N.E. to N.N.W. S.E. to N.E.
May.—S.W. Calms and variable.
June.—S.E. to N.E. Calms.
July.—S.E. to N.E. Calms.
August.—N.N.E. to N.N.W. S.E. to N.E.
September.—S.E. to N.E. and S.W.
October.—N.N.E. to N.N.W. S.E. to N.E.
November.—N.N.E. to N.N.W. S.W.
December.—N.N.E. to N.N.W.

It appears that the N.W. of the Straits is represented by N.N.E. to N.N.W., and the S.E. by S.E. to N.E., and that Blind Bay is only partially affected by the gales in Cook Strait.

For the years 1852–53 we have this proportion:—

Year.	N.N.E. to N.N.W.	N.W. to West.	S.W.	S.E. to N.E.	Calm or Variable.	Gales.
1852	110	35	62	99	60	28
1853	107	34	45	96	83	21

The N.E. is the rainy quarter (southward of the Strait). It is the N.E. gale of these seas; and is but of short duration, veering to N.W. and S.W.

The common S.E. wind of the Strait seldom blows home to Nelson.

The ordinary sea breeze begins from the westward, working round to N.W., and drawing to N.E. at sunset. At Nelson the strongest gales are from S.W.

Rainy weather is generally indicated by vapoury clouds hanging on the hills. When strong gales occur without rain, they are often preceded by a red, wild, and lurid sky. These come mostly from the westward.

The maximum amount of rain was in May 16th, 1853, when 3¾ inches fell in eight hours, the barometer falling to 29·08; on common rainy days, about three-quarters of an inch falls in twenty-four hours.

The average fall of rain in 1852–53–54, for each month, was as follows:—

January, 2·69; February, 2·78; March, 2·53; April, 2·45; May, 3·41; June, 3·37; July, 2·53; August, 3·24; September, 3·87; October, 3·51; November, 2·56; December, 3·44. September, October, and December being the most rainy months. Snow rarely falls on the low lands about Nelson, but the mountain ranges are covered for months. The barometer falls considerably previous to snow storms, which occur in the end of May and June.

Thunder clouds proceed from S.E. to N.W. Thunder occurred on forty-two days during three years, chiefly in January, September, and December. Fogs and misty weather are rare. Dews occur at all seasons. The temperature at Nelson was as low as 26° during three days in August, 1854; the wind being S.S.E. The highest range was 87° in February.

The greatest amount of pressure was 30·50 in April; wind S.E. to S.W. The lowest 28·74, on May 17th, 1853, with much thunder and lightning.

The following Table is from observations in 1852–53–54.

Year.	N.N.E. to N.N.W.	N.W. to West.	S.W.	S.E. to N.E.	Calms.	Gales.
1852	110	35	62	99	60	28
1853	107	34	45	96	83	21

N.B.—These observations were made in the town of Nelson, 120 feet above the sea level.

6.—*Cape Campbell to Cape Saunders.*

About Lyttelton, nearly central in this district, we find the summer sea breezes blow from the N.E. with hazy weather, occasionally changing to N.W. for two or three days. The summer sea breeze dies away at sunset, and is succeeded by a light S.W., springing up about midnight, which lasts until 9h. a.m.

In winter the prevailing winds are S.E. at sea, but at Lyttelton and Canterbury the wind is S.W., while at sea it is S.E. In spring and autumn the winds are variable from N.E. for two or three days, with very fine weather; then light winds for a day, shifting to N.W., blowing a gale from twelve to forty-eight hours; then a sudden shift to S.W., strong wind and rain for three days, when it comes round again to N.E. along shore.

Fortunately it seldom blows strong from East, but even light winds from that quarter produce a heavy swell in Port Cooper. This wind is accompanied by fog and misty rain.

The violent S.W. wind in this harbour off the land is accompanied with more danger to shipping than any wind that has blown in. In December we experienced a south-easter between Canterbury and Otago. It fell calm for an hour, when the S.S.E. wind came up suddenly, and with little warning; it veered to S.S.W. This S.W. wind corresponds to the south-eastern of Cook Strait.

It is very necessary to be aware of the prognostics of the sudden changes along this coast, especially the north-wester, which comes on at once to blow furiously. The most unmistakeable sign is a remarkable transparency of the atmosphere, which is very clear indeed.

The N.W. wind of this district resembles the sirocco of the Mediterranean; it comes on suddenly, and changes the temperature in a few minutes from 12 to 20 degrees. This change in the temperature perhaps arises from the rapid melting of snow in crossing the Southern Alps, or from crossing heated plains.

The S.W. wind is preceded by heavy, hard-edged, dark cumuli in that quarter. At sea this is probably S.S.E.

Again, the mountains are clouded in a south-easter, and partially in a south-wester:—while all distant objects, including the Kaikoras, are distinct, with a fine blue tint, on the approach of the N.W. wind. The finest months are December, January, February, and March. Rains and gales are chiefly in June, July, and August. The rainy quarter is N.W. to S.W. The hot north-wester in summer frequently terminates in wet. There is also a wet and a dry south-wester. In autumn or winter the barometer rises very high, with light East winds, producing fogs and much rain, lasting ten or fourteen days.

The barometer is very variable on this coast; its fluctuations amount almost to a puzzle on shore. It is supposed the lofty mountains must have some share in producing local pressure, as the mercury is frequently moving, though no apparent atmospheric disturbance takes place.* The following remarks are specially applicable at sea. In winter the mercury falls previously to a S.S.E. or S.W. gale, but immediately before commencing it rises, and when at its greatest height the gale blows strongest. In winter such a gale brings continuous rain for three days; but in spring and autumn severe squalls, with rain, hail, and sleet, the glass remaining high, and it is succeeded by N.E. wind and fine weather. The mercury falls before a N.W. gale, especially if followed by a wet S.W. wind: the change is often immediate. It is very low when snow falls, although without wind.

At Lyttelton the barometer has been very low for many days without any change: it has been at its highest with very bad weather, and soon after at its lowest with very fine weather. It appears that the cyclone north-easter does not occur above four times a year, then the rain from this quarter is heavy. The greatest fall of rain yet known in twenty-four hours was 2·14 inches in April, 1853.

The uncertainty of the weather is shown to be remarkable by the following example:—The rain that fell in,—April, 1852, 3·09 in.; April, 1853, 9·40 in.; April, 1854, 1·08 in.

April is considered a fine dry month, but in 1853 more rain fell than in any other month. Snow rarely falls on the plains, but it has fallen in May, July, August and September. In August, 1851, there was a heavy fall of two inches deep, that lay all day. Thunder and lightning are rare. Their clouds proceed from N.W. or S.W., with dense cumulo-stratus. This occurs in spring and autumn.

The temperature at Christchurch has been as low as 27° (June 10th, 1852); the highest was 91° in the shade on February 1st, 1854, at 3h. p.m. The greatest amount of pressure was 30·64, August 14th, 1854; the least pressure, 28·85, May 17th, 1853.

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* Similar effects have been noticed near Tierra del Fuego.

The following Table is from observations in 1852–53–54, at Christchurch:—

Year.	N.N.E. to N.N.W.	N.W. to West.	S.W.	S.E. to N.E.	Calm or Variable.	Gales.
1852	4	20	112	119	110	..
1853	6	21	115	120	103	..
1854	5	27	99	151	83	..

On only two or three days in each of the years 1852, 1853, and 1854, was any thunder heard.

It has been a matter of surprise and speculation that the hot N.W. winds proceeding directly from the snow should produce considerable heat, instead of (as would appear natural) an opposite sensation; nor can it be accounted for by the air traversing the plains, as the heat is found fully as sensible and perhaps more so at the foot of the snowy range.

We may, perhaps, account for it thus:—We find this hot N.W. wind is preceded by cloudless serenity; therefore a great deal of radiation is taking place. The melting surface of the snow covering the heights releases latent heat, causing the atmosphere to become highly rarefied, which consequently rises, but, meeting an upper current, becomes cool and condensed, and rushes towards the coast, carrying at first a portion of the lower strata of caloric, the immediate sensible precursor of the gale. In a few hours the equilibrium is restored, and condensed moisture falls in rain, which is frequently the termination of the gale.*

At Akaroa this gale is seldom felt, being sheltered by the Peninsula mountains. In this place the sea breeze follows the bends of the harbour. S.W.† gales follow N.W. winds, and blow very hard. The land wind has more than ordinary strength in passing Akaroa Heads in the morning.

At Otago no register appears to have been kept previous to 1854.

Our information regarding the weather there is gathered from an intelligent pilot, who resided sixteen years near the Heads.

North winds are rare. The ordinary sea breeze is N.E. It seldom blows from East.

S.E. winds are accompanied by thick, hazy weather, but seldom blow home.

South winds do not blow strongly, unless they veer to S.S.W. and S.W.

The winds off the land are the strongest, and W.N.W. winds blow the hardest, the latter being at times a hot wind. The squalls from this quarter are heavy.

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* Perhaps this hot wind is a tail of an Australian "brickfielder." Compare relative positions on the map; and consider the direction from which this remarkable wind blows. It is not felt far North or South of this particular section of New Zealand.—R. F.

† S.E. outside and in Cook Strait.

The heaviest gales are in November, often with large hailstones.

The dirtiest weather is in June and July. January is the hottest, and July the coldest month. Snow falls and lies on the ground for two or three days in June, July, and August. South to S.E. is the rainy quarter.

The pilot considered that there are about thirty days in the year when it would not be prudent to cross the bar because of the swell, which is worse in attempting to leave. He states that 1853 was a peculiarly dry season. It is curious that in that year there should have fallen at Canterbury nearly double the annual average amount of rain, and that in all other parts of New Zealand it was remarkably dry.

The effects on the barometer may be generally assumed as similar to those of Canterbury, allowing for 2½° higher latitude: At Otago there is much more fog.

7.—*Cape Saunders to Foveaux Strait and to* (8.) *the West Coast of Middle Island.*

There is less information of the weather in this district. In the summer season the N.E. winds and Otago weather extend to the Traps; but after passing the meridian of Stewart Island, a very different climate may be met with. We found on two occasions that on approaching the West coast, N.N.W. gales blew down the West coast, with thick foggy weather.

It is said that in summer easterly winds blow occasionally for six weeks at a time. It is, therefore, as well for vessels bound eastward at that season to pass considerably South of this latitude, unless it is wished to make a landfall.

We may allow the district between Hawke Bay and the East Cape the superiority of climate; although that of Nelson is more bracing.

The Bay of Islands claims an exemption from the ordinary humidity of the northern district.

Auckland is subject to more moisture, although no more rain falls than is necessary for the prolific vegetation, which its excellent soil and delightful temperature produce.

The summer during two years, 1853 and 1854, was even too dry, threatening a drought.

Having concluded this statement of the Meteorology of New Zealand, as far as we have been able to collect facts from imperfect observations, and our own knowledge of the coast, we may remark that the climate is in general peculiarly adapted to colonists of our race. That the navigator will experience frequent changes, but is well warned by certain prognostics with the assistance of his barometer. That all gales are of short duration. And that the temperature throughout the year is so equable, especially in the northern portion, that it is difficult to define the limits of summer and winter.

CLIMATE OF PONAPE.

The climate of Ponape or Ascension Island, one of the Caroline Group of the Pacific Ocean, in lat. 6° 55′ N., long. 158° 25′ E., has been thus described by L. H. Gulick, M.D.

Average for the Three Years, 1853–54–55.

Far. Thermometer.—Mean at sunrise, 78·28°; mean at noon, 83·31°; mean at sunset, 79·27°; maximum, 89°; minimum, 70°; range, 19°; mean, 80·28°.

Weather.—Number of clear days, 252; days with a slight sprinkle, 74; showery days, 447; rainy days, 130.

Electrical Phenomena.—10 days with thunder, 3 with lightning.

It is to be questioned whether there exists a series of observations exhibiting as great a uniformity as those years present, if even as great, in any part of our globe. The South Seas, generally notorious as they are for salubrious equability of temperature, have probably not yet presented anything equal to this.

The mean daily range is about 5°.

The mean difference of successive days is about 1°!

The utmost range of the thermometer, during three years, was from 89° to 70°, only 19°!

The mean temperature of three years was 80·28°.

Facts in connection with remarks on the winds and weather, will account for this singular equability, particularly the immense expanse of ocean surrounds all these Micronesian Islands.

The predominating winds are the N.E. trades. During the northern winter, while the sun is in southern declination, and while, consequently, the whole system of aerial currents is drawn to the South, the island is fully exposed to their action. This period usually lasts from December to May, inclusive; though there is much difference in different seasons. At times, the trades do not set in till January, and, again, they begin steadily as early as November, and cease at any period from April to June. There are certain seasons when they are but faint, even during the dead of winter, as in January and February, 1856; and, again, they may continually intrude themselves during all the summer, as in 1856.

The severer class of gales are comparatively unknown here. The typhoons of the China Sea, and even of the seas North of the Ladrones, about the Bonin Islands, almost never extendto this island. Yet once, during the youth of a few of the very oldest inhabitants now living, a desolating wind swept over the island, so tearing up the bread-fruit trees—the principal reliance for food—that an awful famine ensued, and large numbers died. It would seem possible that this was a cyclone. And it is very interesting that a similar gale produced similar results on Strong Island, five degrees East of Ponape, and that, too, in the memory of the very oldest inhabitants.

May not this have been the very same erratic cyclone that swept Ponape?

Of the weather:—Without accurate udometric figures, there is much humidity, though nothing excessive. Situated just on the southern confines of the N.E. trades, and under the northern edge of the cloud zone over the equatorial regions between the two trade wind zones of the North and South hemispheres, the island is constantly exposed to precipitations from above. Before the trade winds reach the island, they have made their passage over thousands of miles of ocean, and have become saturated with moisture; so that, as soon as they impinge on the central elevations of our island, some of which are 2,858 feet in height, the clouds are arrested and showers fall; and, as the island is but little more than fifteen miles in diameter, they readily pass over them and water the lee no less than the windward slopes. And again, during the summer, while the trades have receded northwards, we are, ever and anon, shaded by the equatorial clouds, which pour their contents most bounteously; yet we are constantly so near the northern boundery of this zone, that we do not experience its severer, its protracted and unpleasant pouring rains of weeks and months The humidity is consequently more equably distributed through the year than in most tropic regions; yet we speak of the summer as the season most rainy, if not as the "rainy season." The year, 1856, during which the trades were very faint through all their usual months, and were quite intrusive through all the months during which they usually absent themselves, was the most dry remembered by the oldest inhabitants.

Of the electric phenomena, thunder is rare and lightning still rarer. Thunder was heard only twenty-eight days in three years, and lightning seen only eight days. So very seldom does lightning prove destructive, that the natives have never suspected its agency, but attribute its results to a direct visitation from their *Ani* or Spirits, the only gods they reverence.

ROUTES FROM SINGAPORE TO NEW CALEDONIA AND THE NORTH-EAST COAST OF AUSTRALIA,

From November to March, Inclusive.

Southern Route.

Vessels bound to the south-eastern colonies of Australia almost invariably adopt the Southern Route at all seasons of the year, entering the Indian Ocean by the Strait of Sunda. The passage to Sydney, under very favourable circumstances, has been made in seven weeks, and that to Melbourne in a few days less; but the average is between nine and ten weeks. The passage to Port Curtis or New Caledonia will occupy ten days or a fortnight more, if no intermediate port is touched at. None but staunch and well-found vessels should attempt the passage.

Vessels leaving Singapore in the season from November to March will carry northerly or N.W. winds until to the southward of Banka and Billiton, when the wind may be expected from West and W.S.W. If it should prove strong and steady, it would be advisable to bear up at once for Bally Strait, as much loss of time is experienced by attempting to beat out through the Strait of Sunda during the spurts of westerly wind, which sometimes hang at S.W. for days together. Indeed, commanders who have had opportunities of testing both straits at this season will be disposed to run at once for that of Bally on leaving this port.

Bally Strait has latterly come to be much used by the homeward bound Dutch ships from Java, even vessels that have loaded at Batavia running down nearly the whole length of the island to avoid a dead beat out of the Strait of Sunda. Pilot cutters are always cruizing during the season under the lee of the land to the northward of the strait, as the commanders of the Dutch Indiamen are under instructions not to pass through without a pilot; but his assistance is scarcely necessary, as there are no hidden dangers in the narrow part of the strait. All Dutch ships anchor at Banyu Wangi for live stock and fresh water. The latter is particularly good and easy of access, as it is led down from the spring in the mountain by an aqueduct, which is carried out into the sea beyond low water mark. As good water is scarcely attainable by shipping on the North-coast of Java, this convenience may have something to do with the popularity of the strait. There is never any difficulty in getting out of the strait to the southward at this season, even with a S.W. wind, as the strait opens to the S.E.

The S.E. trade will be met with in from 10° to 16° S. Sometimes there is only an interval of a few hours between the cessation of the monsoon and the setting in of the trade wind. But there is more generally a week or ten days of calms, light airs, and occasional squalls from the southward before getting the regular trade. It extends at this season as far as 32° S., and S.E. winds are often experienced as far as 40° S., when it will be advisable to stand on into the westerly variables, which prevail about that parallel.

Vessels bound to Port Curtis or New Caledonia should pass to the southward of Van Diemen Land, as easterly winds prevail in Bass Strait during the summer season. In these high latitudes the winds are sharp and bracing, but a native crew will not suffer much if well clad. After passing Van Diemen Land, a vessel bound to Port Curtis should not approach the East coast of Australia nearer than three hundred miles until near the parallel of Sandy Cape (24° 40′ S.), as N.E. winds prevail along shore. A direct course may be made to New Caledonia after rounding Van Diemen Land. Should supplies be required before the passage is completed, Hobart Town is the most convenient port to touch at.

Eastern Routes.

The Eastern or more direct routes to Port Curtis and New Caledonia can only be adopted with a tolerable certainty of meeting with favourable winds throughout the passage, by vessels leaving Singapore between the middle of November and the middle of February. The route to the North of New Guinea, which, from the first half being identical with that followed by ships bound to China by the Eastern Passage, may be called the "Eastern Passage Route," is best suited for vessels over 150 tons burthen. Smaller vessels, more especially if the number of people on board is so great as to render supplies of wood and water necessary during the voyage, should take the Torres Strait Route, which, indeed, is the only one that can be adopted with ordinary safety by vessels under eighty tons burthen.

Eastern Passage Route.—The first half of this route is so well known, from its being frequented by vessels bound to China during the westerly monsoon, that it will only be necessary to notice the ports on this portion of the route that are most convenient for obtaining supplies, should they be required. These are Bonthain, at the South extreme of Celebes, and Gebi, an island in the Gilolo Passage. The former has a secure and convenient anchorage during the westerly monsoon; and fresh water, wood, fruits, vegetables, and live stock can be obtained on very moderate terms. The water is particularly good, as it is supplied by springs in the Lumpo Batang mountain, at the foot of which Bonthain is situated. Gebi also has an excellent anchorage, and the water is of the best quality; but in other respects it is not so good a refreshment port as Bonthain, besides which, it is a little out of the way if the most direct route through Dampier or Pitt Strait is taken. But it is the last port on the route at which it will be advisable for small vessels to touch, as Port Dory is not convenient, and the natives of the islands further to the eastward, although extremely anxious to trade, are a formidable race, and intercourse with them had best be avoided.

The first navigator that passed along New Guinea from West to East was the celebrated Dampier, who became aware of the existence of a westerly monsoon in these seas while cruising with the buccaneers. When on their return to Europe from the West coast of America, in the year 1687, they touched on the coast of Celebes, and, departing in the month of November, they met with westerly winds, which obliged them to stand to the South, past Timor, until they reached the N.W. coast of Australia. Twelve years afterwards, Dampier returned in a king's ship, the *Roebuck*, for purposes of discovery, and leaving Timor on the 12th of December, he sailed for the coast of New Guinea with westerly winds, and passed through the strait that bears his name to the North coast, along which he ran as far as New Britain (more than 1,200 miles), which he circumnavigated and examined. The westerly monsoon was very strong this year (1699) often amounting to a "fresh gale," and they were unable to commence the return voyage until nearly the end of March. The westerly winds, however, did not cease until a month afterwards, but they found a current setting in the opposite direction at the rate of a mile an hour.

The sea between the Barrier Reefs and New Caledonia must be considered a region of variable winds during the period in which the S.E. trade wind is held in abeyance by the westerly monsoon.

The following paragraph on the winds in this neighbourhood is extracted from a paper on the Steam Route through Torres Strait in the *Indian Archipelago Journal* for 1851, p. 493. Several additional passages from West to East by sailing vessels have been made since that time, but the additional experience has not rendered any correction necessary.

"Hitherto Torres Strait has only been navigated generally by ships passing from East to West; but on three or four occasions vessels have sailed through in the opposite direction. This passage, however, has always been attended with great delay, as it was found that the westerly monsoon, which prevails from November to March inclusive in the seas of the Indian Archipelago, does not blow steadily within Torres Straits, where it only appears in spurts of eight or ten days' duration about the change of the moon. Occasionally these westerly winds blow with considerable strength; but they are usually unsteady, in fact mere interruptions of the S.E. trade wind. These spurts may be expected in November and in the following months until March. Sometimes, but rarely, they are encountered as late as April. In this month of 1844, the writer, while *en route* from Sydney to Port Essington by the Middle Passage, met with a spurt of N.W. wind when in lat. 19° S., which lasted from the 24th to the 29th of the month. It blew a steady six-knot breeze throughout this period, and the writer was subsequently able to trace it to Port Essington, the Arru Islands, and Macassar, where it blew with some strength, and was remarked as an unusual occurrence so late in the season. This period appears to be the fine season in Torres Strait, (as is the case in the Moluccas,) at least to the South of Cape York, as this is the time chosen by the Murray and Darnley Islanders for making their annual excursions to the islets which lie off the N.E. coast of Australia. The question of winds is, however, of little importance when steam routes are under consideration, especially on the present occasion, as parties interested will be satisfied on learning that no winds have ever yet been experienced in Torres Strait which are calculated in the slightest degree to interfere with the progress of steamers in either direction."

The *Circe* ran down from Java to Amboyna with the West monsoon, and left the latter place on the 16th December (1849) for Ternate, where they were to receive their instructions; but, meeting with strong N.W. winds (the same spurt that the *Mæander* experienced in that neighbourhood) and a strong current setting to the eastward, they were forced to put into Wahaai, a port on the North side of Ceram, where they heard of the *Mæander* having passed. This was on the 24th of December, and they lay wind-bound until the 13th February, when they put to sea, and reached Ternate on the 25th. It was not until the 15th of March that they finally sailed for New Guinea, and arrived at Gebi, an island in the Gilolo Passage, on the 19th. Here they were joined by a fleet of Molucca prows, belonging to the Sultan of Tidore, which accompanied them for the remainder of the voyage. Leaving Gebi on the 26th March, they passed through Dampier Strait, were abreast of Cape Good Hope on the 29th, and entered the Great Bay on the 31st, where they anchored at Port Dory. The direction of the wind from leaving Ternate is not given, but it must have been favourable throughout.

The *Circe* remained at anchor at Port Dory until the 25th April waiting for the flotilla of prows, which did not join until the 20th. The winds during their stay are stated as follows:—"From the 1st to the 22nd April the wind for the most part was S.E. and N.E., which towards evening was often alternated with N.W., seldom with S.W. winds." Weather fair, but occasional showers. On the 25th, left Port Dory with light westerly winds, and stood into the Great Bay, where several trading stations were visited, and on the 11th of May they anchored at the N.E. point of the bay. During this period, regular land and sea breezes were experienced, the first at S.E. and the latter at N.W., but an adverse current was found in the offing, setting W.N.W. On the 24th of May a strong breeze set in from S.S.W., which in four days carried them up to Humboldt Bay; but as they were about to enter, the wind shifted to S.E. and E.S.E., with a chopping sea, and the *Circe*, being a slow and far from weatherly vessel, was forced to bear up and return to Amboyna.

The *Mæander* lost the strong westerly wind and favourable current when she approached the Admiralty Islands. It is therefore a question whether she would not have made a more rapid passage by running down her easting along the line as far as Schanks Island, or even farther, if the wind held, when, by getting into the S.E. trade, she would have had a free wind for the remainder of the passage.

New Caledonia.—As regards vessels bound to the French settlements in New Caledonia by the Eastern Passage Route, there can be no doubt that it would be advisable to run down their easting along the line, even as far as the meridian of 150° if the wind holds, as the trade will be met with at this season, when well to the eastward, in about 10° S., blowing steadily between East and E.S.E. as far as 20° S., this will enable them to lay to windward of the New Hebrides Group, which, with New Caledonia, seems to be the barrier between the trade wind of the South Pacific and the variables of the Papuan Sea.

Torres Strait Route.

The Torres Strait Route to Port Curtis from Singapore is the most direct, the distance being 3,400 nautical miles. This route is better suited for small than for large vessels, for although the depth of water is sufficient for the largest ships, and the navigation is no where more difficult than that of the Straits of Malacca between Pedra Branca and the North Sands, still commanders who have been accustomed chiefly to open sea navigation often feel uncomfortable. But, on the other hand, it is the only route that can be adopted with safety by vessels under eighty tons burthen, unless they carry a much larger supply of water than is usually the case, for there is no place near the Eastern Passage Route, after passing Port Dory, where a small vessel can obtain water with safety, owing to the formidable numbers and character of the natives, who, although friendly enough towards large vessels, might be tempted to lay violent hands on small craft.

The track as far as Bonthain will be the same as that of the Eastern Passage Route, but after passing through Salayer Strait a south-easterly course has to be followed towards the North side of Timor, along which the track passes. If supplies are required, Manatuti, a Portuguese settlement about eighty miles East of Dilli, is the best place to touch at, as the road is sheltered from the westward by a point of land; but if the breeze is fresh from any point to the northward of West, it will not be safe to approach the coast very close. In that case, the bay on the West side of Kissa, or the South coast of Moa, will be the best place to visit, as small vessels can lie close to the shore, and the anchorage is perfectly safe at this season. Fresh water, poultry, fruits, and vegetables, including excellent yams and sweet potatoes, can be obtained here in any quantities that may be required on very easy terms, as cash is almost unknown and the natives gladly exchange their produce for small cutlery, calico, pieces of bar iron of the size required for a parang, empty bottles, old clothes, buttons, and other trifles. At Kissa there will be a slight delay, as the chief villages are all on the East side of the island, and two guns should be fired as a signal for trade. At Moa, the best place to touch is a bay on the South coast, about four miles beyond the S.W. point, where there are four villages close to the shore—of which Patti is the most important—and an old Dutch fort. The chiefs and principal inhabitants of Kissa and Moa are Protestant Christians, and Dutch missionaries resided at both places during the existence of the establishment at Port Essington, when there was frequent intercourse, the natives proving particularly friendly towards Europeans.

The Macassar prahus employed in the trepang fishery in the Gulf of Carpentaria (high-sterned vessels, with the tripod mast) always adopt this route. They leave Macassar about Christmas, and generally touch at Dilli or Manatuti to fill up water and dispose of some native cloths, and also occasionally at Kissa, Letti, and Moa; but those that leave later in the season make one run of it, and sometimes complete the passage from Macassar to the Gulf in ten days.

Endeavour Strait seems to be the best entrance to Torres Straits from the westward, now that the survey has been completed. The following directions will carry a vessel in by a channel where the least depth is 4½ fathoms at low water:—

"The western entrance of Endeavour Strait is easy to make. At a distance of 120 miles to the westward the soundings begin to decrease from thirty-six fathoms, the usual depth across the mouth of the Gulf of Carpentaria, to thirty, twenty, and nine fathoms as the strait is approached. The only precaution necessary to be taken when running for the strait is to avoid going to the North of the parallel of Booby Island, as there are some shoals to the W.N.W. which have not been well examined, from being out of the usual track. To the South of this parallel the sea is perfectly clear of danger and has been well explored. In clear weather Prince of Wales Island, which may be seen from a distance of thirty miles, will probably be made before Booby or Wallis Islands, which, although moderately elevated, are not visible from a ship's deck much more than fifteen miles. There are several channels into the strait through the sandbanks which project from Prince of Wales and Wallis Islands and from the mainland, but the widest and most available is that which lies immediately to the North of Red Wallis Island. By bringing Booby Island to bear N.b.E., mag., distant ten miles, when Red Wallis will bear E.b.S.¾ S., a direct course steered for the latter will lead clear into the strait between the spits which project from Cape Cornwall and the Wallis Islands, and will also clear two patches of three fathoms which lie in the channel. The depth is from four and a half to eight fathoms. The strait is perfectly clear within, with the exception of the Heroine and Eagle Rocks, which may easily be avoided; and, as it has been repeatedly examined and sounded in the course of the last eight years by Captains Blackwood, Stanley, and Yule, Endeavour Strait may be considered as one of the best surveyed spots in the Eastern Seas."

Nearly a dozen passages have been made from India to Sydney by way of Torres Straits, mostly at long intervals, with the exception of the three voyages of the brig *Heroine*, Mackenzie, in 1844–5–6, but although no accident took place, the results were not sufficiently favourable to lead to a more general adoption of the route. All these vessels passed through the Barrier into the open sea as soon as possible, and were delayed by the variable winds, which are now known to prevail at a distance from the land. It was not until 1847 and 1848 that the inner passage along the land came to be tested by the vessels employed in attending Mr. Kennedy's overland expedition from Rockingham Bay to Cape York, when it was found that the easterly winds often experienced outside the Barrier very rarely blow home on the land, and that north-westerly winds occasionally blow along the coast for days in succession. The monsoon, however, more generally appeared in the form of a land wind, rising about midnight and blowing through the greater part of the following day, when it would fall calm until midnight. This inner route, too, has the advantage of having been accurately surveyed by the late Captain King, and of being perfectly free from coral, which is attributed to the fresh water from the rivers being carried along the coast by the tides. The navigation of the inner route is also comparatively easy, owing to landmarks being always in sight during the day, and often during the night also, for the weather is remarkably clear, this being the fine season. Showers are often experienced, particularly during the night, when the land breeze comes off, and much rain falls on the high land of the interior, as is shown by the volumes of fresh water poured out by the rivers.

Nevertheless, the passage along the coast from Cape York to Port Curtis will occupy more time than would be expected from the smallness of the distance, a little more than 900 miles, for it will be necessary to remain at anchor during dark nights for the first 500 miles after leaving Cape York, and if the passage is made in twelve days it will be a favourable run.

New Caledonia.—Vessels bound to New Caledonia by the Torres Strait Route should enter by Prince of Wales or Bligh Channel, and take the wide northern passage discovered and surveyed by Captain Blackwood, of H.M.S. *Fly*, the entrance of which from the Pacific is forty miles wide, with regular soundings. Hence, along the South coast of New Guinea and the Louisiade West and N.W. winds may be expected without interruption during December, January, and February, and probably much later, for the mass of high land creates a temperature which causes a rush of air towards the region of variables to the S.E.

The following memoranda are from the journal of H.M.S. *Rattlesnake*, in December, 1849, and January, 1850, while completing the survey previous to sailing for Sydney:—

Dec. 11th, 1849.—A light air from the N.W. (Darnley Island).

16th.—Light winds from the 11th. This day "a strong N.W. breeze, which came on last night, and caused us to drag the stream anchor."

19th.—Left Bramble Kay with a fine breeze from the N.W.

20th.—Wind N.W. At daylight abreast of Cape Possession.

21st.—Light north-westerly breeze.

28th.—Since the 21st at anchor in Redscar Bay. During the week "the wind was usually from the westward, varying between N.W. and S.W., and on one occasion had a sudden and very violent squall from the westward." This is the identical week during which the *Mæander* made her longest runs on the North coast of New Guinea with N.W. winds and a strong current in her favour.

Jan. 6th. 1850.—"Our passage to the Duchateau Islands (Louisiade Group), a distance less than 400 miles, has been protracted [the *Rattlesnake* sailed from Redscar Bay on the 31st December] by the prevalence of light winds, although these were generally favourable, or from the westward. Occasional calms, squalls, and rain occurred, but the weather generally was finer than during the S.E. monsoon."—(Vol. ii., p. 60.)

The *Rattlesnake* left the Louisiade for Sydney on the 8th of January. This part of her voyage has already been spoken of in the notes on the Eastern Passage Route, but the following memorandum by the historian of the voyage may be added:—"Our daily average progress during the passage to Sydney (which occupied a period of twenty-eight days) was less than fifty miles.* The winds for the first few days, or until beyond the influence of the land, were light and variable, shifting between S..W. and N.E. by the northward, and accompanied by occasional squalls and rain. It became a matter of difficulty to determine when we got into the S.E. trade; it was not until we reached lat. 20° S. that the wind, light on the preceding day, but on this strong, with squalls and rain, appeared steady between E.S.E. and S.S.E., and this carried us down to Sandy Cape." (East coast of Australia, lat. 24° 45′ S.)—*Singapore Free Press.*

ROUTES FROM SINGAPORE TO NEW CALEDONIA AND THE NORTH-EAST COAST OF AUSTRALIA,

From May to September, Inclusive.

Southern Route.

During this season the quickest passages have been made to the Australian colonies by the southern route; for although some delay is experienced in getting to the strait of Sunda against the S.E. winds, there is no difficulty in passing through the strait into the Indian Ocean, where the trade wind is usually strong and steady as far as 28° S.; after which the westerly winds which blow with great strength to the South of that parallel soon carry a ship to her destined port. And as these winds curve round Cape Howe, and blow from the southward and S.W. along the East coast of Australia as far as the tropic, no difficulty will be experienced in reaching Port Curtis and New Caledonia at this season.

The only disadvantages connected with the route are the foul winds that will be experienced at first starting, and the inclemency of the winter season in high southern latitudes; where the cross seas which get up when the wind chops suddenly from N.W. to S.W., which often happens, are of a peculiarly dangerous character. This route, however, is so well known, at least as far as Bass Strait, that it is only noticed here for purposes of comparison.

Northern Route.

The passage from Singapore to the Australasian colonies by way of the North Pacific has never yet been tried, nor would it be advisable for any vessel bound to a settlement South of Moreton

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* It should be mentioned that the *Rattlesnake* was a remarkably dull sailer She was a frigate-built ship of 450 tons, and carried twenty-four carronades when a war vessel. She was rigged as a barque, and had a large poop built on her when she was fitted for the surveying service.

Bay to make the attempt, as great difficulty would be experienced in getting to the southward against the southerly and S.W. winds which prevail between the East coast of Australia and New Zealand, and which have much the character of the monsoon that occurs at the same season in the Mozambique Channel. Ships from China to the southern colonies by the Pacific route are often greatly retarded by these winds towards the conclusion of the voyage, which has made the route very unpopular of late, and it is not much used now except by vessels carrying native passengers, when it is an object to avoid the inclement weather of the winter season to the South of Australia. Ships carrying freight from China and Manila generally stand to the southward when they get the N.E. trade, and enter the Indian Ocean by the Gilolo Passage and Timor Straits, after which the southern route is pursued.

During this season the N.E. and S.E. trade winds of the Pacific blow with steadiness and regularity, and ships pass from one into the other, on crossing the line, without an interval of calms or variable winds. And as the S.W. monsoon blows steadily between this port and the N.E. coast of China, the only point on which details are necessary is with respect to the facilities for running down sufficient easting in the northern variables to enable a ship to lay up across the trades so as to fetch to windward of the destined port.

The wind and current charts of Lieut. Maury, U.S.N., which have proved so useful to navigators, give the prevailing winds in the North Pacific from the coast of China as far as 150° E. The accompanying table which is compiled from sheet No. 3, series C. (1853) of these charts, shows the winds experienced during the months of May, June, July, August, and September, by the ships from whose log-books he compiled his chart (chiefly whalers and vessels running between China and California). They are at least as favourable for making easting as those experienced to the South of Australia during the summer season, and they will appear much more favourable when the observations of the U.S. squadron recently employed in the Japan Sea come to be inserted. The squadron left Shanghai for the Loo Choo and the Bonin Group on the 23rd of May, 1853, and carried the S.W. monsoon throughout the passage. The following extract is from the authorised account of the expedition, compiled under the supervision of Commodore Perry. "As during the return voyage moderate breezes from S.S.W. to S.W. prevailed with warm weather, and as, in fact, the wind ever since the first departure from Napha (Loo Choo) had continued from the southward and westward, it may be inferred that the S.W. monsoon extends as far North as the parallels of latitude in which the course of the ships laid." (p. 245).

The Gulf Stream which is found in these latitudes will also materially aid a ship in making her easting. It is so little known, and of such importance to navigation, that the entire report of Lieut. Bent, the officer employed to observe the phenomena, is given below. This singular current, with the water at a temperature of 86°, affords a clue to the mystery of the Bonin Islands having an exclusively tropical vegetation, which has long been a puzzle to naturalists. It also accounts for the productiveness of the southern islands of the Japan Group in sugar and other produce which is usually confined to intertropical regions. It will be well for a navigator making his easting to keep in this stream, which he may easily do with the aid of a thermometer, as it is supposed to curve to the southward after passing the Bonin Group, and at the same time is likely to have an influence in producing favourable winds.

In the accompanying track chart, the route is laid down between Formosa and the coast of China, but it is doubtful whether it would not be best to enter the Pacific by the Bashee Channel to the South of Formosa, so as to get at once into the stream of current. It is also doubtful how far a ship ought to get to the eastward before entering the limits of the trade winds. Horsburgh, in the short paragraph which treats on the route of "ships from Macao to the N.W. coast of America, or to Australia," recommends getting into longitude 165° to 170° before standing to the southward of the parallel of 30 S., and in the case of heavy sailing ships this would probably be advisable; but fast and weatherly vessels may safely enter the trades 10° to the westward of this point. It seems, too, that while the S.W. monsoon prevails in the China Sea ships will make more easting by keeping between the parallels of 25° and 30°. This was the course adopted by the Spanish galleons, which made annual voyages from Manila to Acapulco, in South America, for upwards of a century, and they had the benefit of a long experience.

Should water and refreshments be required during the passage, they may be obtained at Peel Island, in the Bonin Group, where there is a secure port on the West side of the island, which is much frequented by whale-ships. There is a population numbering about 100, consisting of a few Europeans and Americans, and the remainder Sandwich Islanders, who grow vegetables and rear stock to supply the ships that call for refreshments. Turtle are also abundant. Further on, near the line are the Kingsmill Islands and Pleasant Island (the latter is in lat. 0° 35′ S., long. 167° 10′ E.), both of which abound in refreshments and are much resorted to by whale-ships.

The details given above will enable a reader to compare the routes and draw his own conclusions, as the distances to be traversed on both routes are exactly the same. Commanders of European vessels, when the crews are well provided with warm clothing, will probably still prefer the southern route, where there is more sea room; but commanders of country ships, or vessels carrying native passengers, are likely to incline to the northern route, where no cold weather will be experienced throughout the passage. Perhaps at some future day, when a trade comes to be established with Port Curtis and New Caledonia, two ships may leave this port on the same day, the one taking the northern and the other the southern route,—and this, after all, will be the only safe test of the comparative merits of the two routes with regard to the time occupied in making the passage.

P.S.—Since the above notes were in the hands of the printer, the writer has examined a number of late Australian papers for reports of the passages of ships from this port during the season that has just closed, but he has only succeeded in meeting with the following, which is taken from the *Melbourne Herald* of October 2nd, 1858. The passage was commenced in the earlier portion of the season, which is considered most favourable; but, being a small vessel, it can only be considered as a criterion for vessels of the same class:—

Hobson Bay.—Arrived.—October 1st, *Caroline*, schooner, 110 tons, Captain L. Wells, from Singapore 18th June. No passengers. The *Caroline* has made a very long voyage from Singapore, caused principally by gales experienced in the S.E. trades and calms in the China Seas. A shortness of provisions had occasioned much discomfort to all on board her.

The Kuro-Siwo or Japan Stream.

The Kuro-Siwo is an immense oceanic current on the East coast of Asia, which will be found on the chart as delineated from the observations made by the expedition, and bears a striking analogy, in every essential point, to the Gulf Stream of the Atlantic.

The results of these observations show quite conclusively that the stream has its origin in the great equatorial current of the Pacific, from which it is separated by the South end of Formosa, about the latitude of 22° N., long. 122° E.; whence it is deflected to the northward along the East coast of Formosa, until reaching the parallel of 30° N., when it bears off to the northward and eastward, washing the whole S.E. coast of Japan as far as the Straits of Saugar.

Near its origin the stream is contracted, and is usually confined between the islands of Formosa and Majico-Sima, with a width of one hundred miles; but to the northward of the latter it rapidly expands on its southern limit and reaches the Lew Chew and Bonin Group, attaining a width to the northward of the latter of five hundred miles.

The north-western edge of the stream is strongly marked by a sudden thermal change in the water of from 10° to 20°; but the southern and eastern limit is less distinctly defined, there being a gradual thermal approximation of the air and water.

Along the borders of the stream, where it chafes against the counter currents and torpid waters of the ocean, as also in its midst, where whirls and eddies are produced by islands and the inequalities in its bed, strong tide rips are encountered, often resembling heavy breakers on reefs or shoals. Its average velocity between the South end of Formosa and the Straits of Saugar was found to be from thirty-five to forty miles per twenty-four hours. Yet upon one occasion, off the Gulf of Yedo, its maximum strength is recorded as high as eighty miles per day.

To the northward of the parallel of 40° N., in long. 143° E., there is a cold counter current intervening between it and the South coast of Yesso, as shown by a sudden thermal change in the water of from

16° to 20°, which it is believed sets to the westward, through the Straits of Saugar; but the limited stay of the squadron in that vicinity, and the harassing prevalence of fogs, prevented such observations being made as to satisfactorily determine whether or not there was a predominant current flowing in either direction, or whether it was merely the ebb and flow of the tides through the straits. To the westward, however, of a line connecting the North end of Formosa and the south-western extremity of Japan, a cold counter current was again found, which sets to the southward through the Formosa Channel into the China Sea; and it does not, therefore, seem unreasonable to believe that a hyperborean current will be found in the Japan Sea, setting to the sonthward between the Japanese islands and the main coast of Asia, fed by that on the South coast of Yesso, and supplying that one setting through the Formosa Channel.

The Japanese are well aware of the existence of the great stream which washes the south-eastern shore of their empire, and have given it the name of Kuro-Siwo, or Black Stream, from its deep blue colour when compared with the neighbouring waters of the ocean.

It was also noticed by Captains Cook and Kruzenstern and other explorers, but no systematic series of observations, it is believed, has ever before been made upon it.

The average maximum temperatnre of the Kuro-Siwo is 86°, and the difference between its temperatnre and that of the ocean, due to the latitude, is about 12°. There is no counter current intervening between the Kuro-Siwo and the coast of Japan to the southward of the Straits of Saugar, and nothing was found to manifest the existence of such a current as *under-running* that stream; and although the observations indicate strata of cool water lying in the longitudinal direction of the Kuro-Siwo, yet their temperature varied but a few degrees from the main body of the stream, and was almost invariably superior to that of the atmosphere above them. The insular position of Japan and the separation of the cold counter current from the Kuro-Siwo allowing the latter to hug close along the south-eastern shores of the islands, have a modifying influence upon the climate of the empire, making it milder and more equable than in corresponding latitudes on the East coast of the United States.

There is a floating seaweed found in the Kuro-Siwo similar in appearance to the *Fucus Natans* of the Gulf Stream.

In the passage of the *Mississippi* from Simoda to the Sandwich Islands the thermometer showed a cold aqueous space between the meridians of 155° E. and 170° W. and the parallels of 30° and 35° N., which bears a general correspondence in the Pacific to the position of the Sargasso Sea in the Atlantic.

WINDS AND CURRENTS OF THE WEST PACIFIC OCEAN.

Mr. Horsburgh briefly states that the West monsoon, which blows regularly in the Indian Ocean, extends to New Guinea. This monsoon blows as steadily, strongly, and regularly along the North side of New Guinea, at New Britain, New Ireland, and all contiguous islands South of the equator, so far eastward as Malanta and the northern part of the New Hebrides, as in any part of the Indian Ocean whatever; and extending in a wind of gradually decreasing constancy and continuation from hence far eastward to the Society Islands and Marquesas. The limits in latitude appear similar to the Indian Ocean, from 1° N. to 15° S., occasionally to 19° S., and the period from the beginning of January until the end of March.

Having said thus much, as this is written principally with the idea of endeavouring to show the practicability of making passages to the eastward in the Pacific (instead of the circuitous route round New Holland), which I have never heard has been attempted by trading vessels, although performed by whalers continually, I proceed to state a few facts of such passages; and will first attempt to prove the practicability of making a passage to the eastward during the easterly monsoon in South latitude, or from April until December or January, by keeping to the northward of the equatorial current, and between the trades or monsoons.

In October, 1835, being off the Asia Islands, and wishing to make a passage to the eastward, winds light and variable and current running strongly to the westward, against which we could make no progress, stood to the northward, and on the 19th of October were in lat. 2° 6′ N. and long. 134° 11′ E. Having lost the westerly current, pushed to the eastward between the parallels of 2° 15′ and 2° 34′ N. On the 27th were in long. 147° E. From hence stood to the southeastward and made Matthias Island,—it being my object to cruise in this neighbourhood. On the 30th passed through St. George Channel quickly, current favourable, and to the Treasury Islands. Cruised here until 19th of December. Started with a westerly wind, which carried us to 169° 36′ E. on the 26th, having passed on the South side of Banks Islands. Becalmed two or three days; then with variable winds, chiefly from E.S.E., proceeded to the southward, and anchored in the Bay of Islands 15th of January.

These passages were made at a season deemed impracticable, before the West monsoon had set in steadily, by a southseaman of moderate sailing qualities, without using studding sails. The passage to the eastward may, I am convinced, be made at all seasons by pursuing the same plan; which is, as before stated, to keep to the northward of the equatorial current, and between the trades or monsoons. Here you will have a variable wind, chiefly from the westward, with a drain of favourable current at times.

Further to corroborate this opinion,—June 23rd, in 1° S. and 149° E., having been drifted from Matthias Island and New Hanover by a westerly current of two and a half or three knots an hour, stood to the northward, got westerly winds on the equator. With these made easting, and on the 27th reached 155° E. and 0° 45′ S. Made Bouka Point soon afterwards; then found a current equal in strength to that at Matthias Island. At this time the westerly current did not extend quite to the equator.

Again, in September, 1840, being unable to hold on near the Admiralty Islands, in consequence of strong westerly currents, stood to the northward, and when in 0° 24′ N. and in 146° E., proceeded to 2° N. before losing the current; then worked to the eastward, and stood to the southward on the East side of the Green Islands, which are in about 156° E. The passage from Morty to Bouka has also been made in August by adopting the same plan. Although all these passages terminated in the longitude of the Salomon Islands, it was not through inability to proceed farther to the eastward, but merely in consequence of this being the destination. More might be quoted tending to show that these line currents seldom extend northward of 2° N.

During the West monsoon in South latitude it has been a common practice, the last fifteen years, for ships to make passages from Timor to the Salomon Islands; some returning at the commencement of the easterly monsoon, and others spreading over the Pacific. Last year, five ships, which had been cruising in the Indian Ocean, proceeded eastward between January and April: one along the line to the eastward of the Kingsmill Group, another to the Salomon Islands and New Zealand, and the remainder to New Ireland and elsewhere. From all which I wish it to be inferred that any ship leaving Manila between the beginning of December and the beginning of March, or any port from which she can reach the North end of the Molucca or Gillolo passages, or Dampier Strait, between the middle of December and the middle of March, will make a speedy passage to any part of the Pacific Ocean in East longitude; and that during all other seasons the passage is practicable by keeping northward of the equatorial current and between the monsoon winds.

In the period of the West monsoon northerly and N.W. winds prevail to the Cape of Good Hope of New Guinea. Passing eastward of this point the westerly wind will generally be experienced fresh and steady, with a current of two or two and a half knots running to the eastward, and extending from the New Guinea shore to about 1° N. A ship may pass near the St. David Islands without risk of losing this wind or current, and northward of Providence Islands. From hence any of the passages may be chosen, according to discretion. That by the eastern Dampier Strait, although, perhaps, the most direct if bound to Sydney, I should not recommend until the islands northward of New Guinea are more correctly inserted. If St. George

Channel be adopted it may be preferable to steer along the line until in the longitude of the Admiralty Islands; then pass to the south-eastward between these and Matthias Island, thus avoiding the low islands and reefs to the southward. Sail could be carried during the night without fear. Keeping along the equator there cannot be many undiscovered dangers, this track having been a good deal frequented of late years. The other route to the northward of the Salomon Islands, when bound to New Zealand, the Feejee Islands or anywhere to the eastward, appears to be the best. In the case of New Zealand, the tenth degree of South latitude should not be crossed until reaching long. 171° or 172° E.; then steer to the southward on the West side of the Feejee Islands, passing pretty near, as the easterly winds prevail far to the southward in January, February, and March; but by weathering the reefs near the South end of New Caledonia a passage may always be effected.

The westerly monsoon in the Pacific, as in the Indian Ocean, is attended with cloudy overcast weather, squalls, and heavy rains. Some of these squalls are very severe, requiring all sail to be taken in when crossing the wind; even when running close reefs will be found enough. I have experienced several near New Ireland and New Guinea, which generally gave warning and commenced at W.S.W., blowing furiously the first hour, and continuing in a strong gale, veer-to the N.W. for five or six hours.

From lat. 10° S. to the southern tropic hurricanes are likely to be experienced from November until April agreeing also in this respect with the Indian Ocean; and I make no doubt that one of these occasioned the loss of La Perouse and his fellow voyagers. These scourges of the sea are more prevalent near the New Hebrides and New Caledonia than the Feejee Group and Friendly Islands. In fact, the liability to hurricanes appears in exact ratio to that of the S.W. monsoon, or rather to the meridians in which the westerly monsoon blows, differing in latitude; the monsoon seldom extending beyond 17° or 18° S.,—indeed, at times 13° S. is the limit,—whereas hurricanes are experienced as far as the tropic.

From all that I can gather of these hurricanes of the South Pacific, having conversed with several masters who have encountered them, some of whom have had their ships dismasted, I scarcely think they are of that terrific description occasionally experienced elsewhere; and am almost inclined to believe them more often and more severely felt near the islands than well clear of the land, although aware of this disagreeing with the new theory; but future facts will be necessary to elucidate this subject.

They are still of unfrequent occurrence in the Pacific, several years intervening without any ship encountering one. I possess no facts which would be serviceable in pointing out their track or direction of rotation. They will, without doubt, be considered to agree with other places in the same latitude, yet a few more well authenticated descriptions of these southern hurricanes would not appear to encumber the evidence of their uniformity in these particulars.

Near the Friendly Islands (and perhaps elsewhere) storms occasionally happen of extreme violence, blowing from one point and producing similar effects to hurricanes. In November, 1835, eight or ten ships, English and American, encountered one of these near Tongataboo and Eooa from S.S.E., the heavy part of which lasted about eight hours, causing more or less damage to all,—one or two were dismasted. It was described by the masters whom I saw, which included most of them, as being more severe than anything they had ever seen. Ashore at Eooa, it was most violent,—houses and trees blown down and all the crops destroyed. It likewise did great damage at Tongataboo, and was also felt very severely at the Hapai Islands and Vavaoo. Here, Mr. Thomas, the missionary, was obliged to shore his house up, although it was considered by the natives that a gradual decrease in strength had been experienced in proceeding northward. Still further North, the *Nassau* encountered it in 16° N., in the shape of a heavy gale. At all these places the wind was from the southward,—S.S.E. by the ships; ashore they had no compasses, but it certainly was from the southward and without shifting. I have thus endeavoured to be explicit, through an impression that more is required to be known of hurricanes and gales in localities, and having a strong belief that many of the hurricanes, even those producing the most disastrous effects, will be found very local.

Reverting again to the N.W. monsoon:—at the Salomon Archipelago it commences in December or January. In some years these months are tolerably fine. During February and March strong winds, with severe squalls and heavy rains, may be expected. April generally is a fine month, with variable winds; also in May there is a good deal of fine weather. The S.E. monsoon sets in strongly in June, with heavy rains and squalls, and continues so until the end of August: in all these months, nevertheless, there are considerable intervals of fine weather. In September the strength of the monsoon is spent, and the weather is more moderate from this time until the return of the north-wester.

Farther to the eastward, about the meridian of Rotumah, the westerly monsoon is less constant, beginning generally in January, and blowing strongly about seventeen or eighteen days consecutively, then declining; and, the easterly wind returning in a fresh breeze for nearly the same period, the westerly wind again intervenes, usually commencing with a gale, and always continuing in a strong breeze, with squalls and rain;—the easterly and westerly winds thus alternating until the end of March, when the S.E. trade sets in steadily. Proceeding still further to the eastward the westerly monsoon gradually becomes less constant, and finally disappears, I think, somewhere about the meridian of the Marquesas Islands.

Of currents I can only speak in very general terms, these being subject to great changes in many localities. From 1° or 2° N. to about 3° S., a current of two or three knots an hour prevails, taking its course from the wind, which is easterly during the greater part of the year: current, therefore, westerly. I have, however, experienced an exception to this. In July, 1833, on the equator, in long. 175° E., a current of about the strength already mentioned ran to the eastward for fourteen or fifteen days, although the wind was then fresh from the eastward; and I believe such changes have generally occurred once a year, probably induced by a strong S.W. or westerly monsoon in North latitude reaching at this time near the line. They are fitful changes and not to be depended on, nor can I state their extent eastward.

In other parts of this ocean, well clear of the land, there appears to be very little current. Mr. Horsburgh speaks of a drain to leeward, and this seems to express all there is. Indeed, I think the swell may almost account for it; therefore it is obviously not such a serious matter to fall to leeward in the Trades as may be imagined; almost any ship with perseverance may work to windward, the wind varying considerably, and veering at times far to the southward. For instance, in April I have worked up in a dull sailing and leewardly ship from the reefs off New Caledonia to the West side of the Feejee Group. From thence, in June, to the islands called by the natives Fotuna and Alloaffy, (marked in one as Alluffalli in the chart,) and from thence to Wallis Island. Moderate westerly winds of two or three days duration happen in nearly every month.

Off the islands, so far as my observation extends, the currents decrease in strength in proportion to the increase in latitude, that is, the nearer to the equator the stronger the current, and generally with the wind. There are no doubt many exceptions, but without an account of each island, which I am unable to give, no statement can embrace all the particulars, yet one or two instances of such deviation may be mentioned. Cruising to the southward of New Georgia and Bougainville Islands throughout the S.E. monsoon from May until October, in the years 1836 and 1840, the current ran strongly to the S.E. against a strong wind and heavy swell, although at the same time on the North side of these islands it was running as strongly to the westward. Off the North side of New Ireland, where a westerly current prevails, changes to the eastward occur for ten or twelve days at all seasons.

In concluding these remarks, I may be permitted to hope that some of your readers will follow them up. The winds of the western part of the North Pacific seem very imperfectly known. No statement has appeared of the eastern limit of the S.W. monsoon; it certainly enters this ocean. In June I have run to the northward, keeping about 3° eastward of the Philippines, with a fresh and steady breeze from S.W. The same wind prevailed until reaching 27° North and 138° East.

Guam and the other islands of the Ladrone Group are also understood to be subject to hurricanes, for which the inhabitants prepare by lashing down and securing their houses; yet the seasons at which these are most likely to be experienced are not generally known. Having only crossed this locality once or twice in making passages, I can merely give hearsay evidence. The present Governor of Lamboangan, who has resided in Guam two years in the same capacity, informs me that in June, July, and August, also in December and January, they are expected. December, 1832, the *Japan*, a new ship, encountered a severe hurricane in 13° North and about 160° West, the meridian of some of the Sandwich Islands, in which she was totally dismasted, and fears were entertained of her weathering it. This is the farthest to the eastward in the North Pacific of which I have heard.

Currents of the Pacific Ocean.

As it is important to mariners to be informed of [illegible] belts of currents, their general direction, mean velocity, and [illegible] order to avail themselves of them or avoid them when necessary [illegible] this ocean must be entered from the South, it may be as well [illegible] our observations with those of its southern portion, considering the whole to be divided by the equator into two parts. We shall begin, therefore, with the

Southern Counter-Current.—The southern counter-current of the South Pacific, which first appears off the South point of Tasmania, runs eastward. It is made up of two streams: one is the warm current of the eastern coast of Australia, and the other the cold current to the southward of that continent,—although the observations on which this last theory is founded are not so conclusive as those of the former.

This united current flows from West to East along the whole extent of the Pacific, gathering in volume as it approaches the western coast of America. But in about 160° W. long. it separates into two branches. The northern branch, continuing to flow E.N.E. and East as far as the meridian of 80° W., then suddenly turning round North, N.W., and W.N.W., has received the name of the Mentor Current, and mingles with the southern part of the equatorial current, flowing West.

The other branch of this eastern current, formed mostly by the waters of a lower temperature, flows in part to the northward along the West coast of America, where it forms the cold current of the coast of Peru, called also Humboldt's Current; the other part sets to the southward along the southern coast of South America, where it forms the cold current of Cape Horn, taking its course round this cape into the Atlantic Ocean.

The foregoing is considered the southern counter-current of the Pacific ocean. The observations, however, on which it is assumed are not yet sufficient to establish that it does so beyond question, but only seem to indicate it as most probable.

The southern limit of this current, according to the same theory, will be difficult to establish, from the tendency of the cold water to flow towards the equator. But from the combined tendency of the waters to flow from the southward towards the equator with those flowing from West to East, a mean variable direction results, according to the relative strength of these currents.

There is little information concerning the temperature of this counter-current, but it appears that on the parallel of 60° S. lat. the mean temperature was found to be 33°; in 50° lat., 36°; in 45° lat., 43°; in 35° lat., 65°.

The rate of this current at its commencement, between Tasmania and Campbell Island, was found by Freycinet to be on an average 40 miles a day easterly; 29 miles between Campbell Island and the meridian of 140° W. long., its direction being N.E. and N.N.E.; and 17 miles between the meridians of 140° and 100° W. long., its direction being N.E. The rate of this current must be very variable and greatly influenced by winds from N.W. to West and S.W. which blow constantly in this zone of the Pacific Ocean, and often with considerable strength.

Northern Branch of the Counter-Current.—The northern branch of the abovementioned Mentor Current loses itself in the equatorial current. It always flows eastward as far as the meridian of 80° W., when it turns round suddenly by the North to West.

The breadth of this current varies from 350 to 800 miles. Its eastern limit closely approaches Humboldt Current.

Near the parallel of 26° S., where it runs N.E., N., and N.W., in the month of May its rate was found to vary from 18 to 21 miles a day. In its southern part, at the same season, it varied from 10 to 22 miles.

The following temperatures were found in the Mentor Current, crossing it from West to East: at its western limit 72°; 69° in its middle; and 67° at its eastern limit, on the parallel of 33° S. lat. In May the temperature was found to be 67° at this same eastern limit of the current, in 26° S. lat.

The attention of mariners should be directed to this current. The islands of Felix and Ambrose will be found nearly in the midst of it.

Southern Branch of the Counter-Current.—The second or southern branch of the counter-current, after flowing eastward, becomes divided, forming two considerable currents, one setting S.E. and South, the other N.E. and North. This division takes place nearly on the parallel of 46° S., and about the meridian of 81° W.

The S.E. branch forms the current of Cape Horn, alluded to in considering the currents of the Atlantic Ocean. The northern part, flowing N.E., forms the cold current of the coast of Chili and Peru, and has received the name of Humboldt Current.

Current of Cape Horn.—The current of Cape Horn is first found at about sixty leagues from the coast of America, where its principal direction is E.S.E. and S.E. It then becomes S.S.E., and near the coast it assumes the same direction, flowing towards Cape Horn and preserving a breadth of about sixty leagues. Near the land it follows the windings of the shore, but at its outer limit it becomes gradually more easterly as it advances southward towards the South extremity of the land. It thus follows its easterly course round Cape Horn, extending on the meridian of this cape to the southward as far as about the parallel of 60° S. lat. Having passed the meridian of Cape Horn, it takes an E.N.E. direction and flows N.E. into the Atlantic Ocean.

The velocity of this current of Cape Horn varies from ten to twenty miles a day, but it increases as it advances southward near Terra del Fuego, varying from twelve to twenty-five miles a day to the westward of it. Westerly winds accelerate it in proportion to their force, and it becomes imperceptible with S.E. winds. To the eastward of Terra del Fuego, and a little North of Staten Land, the rate of this current was thirty-three miles per day.

On the parallel of Chiloe Island the temperature of the current of Cape Horn in April was 58°; on the parallel of the entrance of Magellan Strait 49°; a little East of the meridian of Cape Horn, 44°; and near Staten Island, 42°.

Humboldt Current.—The current of cold water which flows northward along the coast of Chili and Peru, called Humboldt Current, mingles at first with the Cape Horn Current, separating from it on the parallel of 43° S., flowing E.N.E. and N.E. on the parallel of Valdivia. Off Valparaiso its principal direction becomes N.N.E. and North, and it continues flowing along the coast of America as far as the parallel of Arica. Beyond the bend in the coast where Arica is situated the general direction of the coast of Peru is N. 50° W. as far as Cape Blanco, in 5° S. Humboldt Current, after making the tour of the bend in which Arica is situated, continues to follow the direction of the coast to the N.W., and on gaining the parallel of Payta, near Cape Blanco, it leaves the coast, turning suddenly W.N.W., passing the Galapagos Islands, its North limit being nearly thirty leagues North of them. It thus enters the northern hemisphere of the Pacific Ocean, reaching as far as 2° N., increasing gradually as it flows West and losing itself in the Equatorial Current.

The extent of this current from the coast varies considerably. On the parallel of Valparaiso it is 120 miles; it increases as it flows northward and when, off Payta, it leaves the land, flowing W.N.W., its distance from the coast is nearly 180 miles. On the meridian of the Galapagos its extent is about 500 miles, and it is also the same on the meridian of 105° W.

Occasionally, however, anomalies are found in this current. Thus, in some places, instead of North it flows South at the rate of half a mile or a mile, and even more.

The times at which these changes take place cannot however be anticipated. There seems no apparent cause to occasion this southerly set, which is often met with immediately before or after northerly winds. But this is not always the case, and must not be considered as a general rule.

In the immediate vicinity of the coast of Chili and Peru in many parts a counter-current to that of Humboldt, flowing principally to the southward, is found, following the windings of the shore, with a velocity varying from three to twelve miles a day. This counter-current is necessarily produced by the Humboldt Current.

The temperature of the water of the Humboldt Current increases gradually as it flows to the northward; but the increase is considerable, as may be seen by the following observations:—In the latitude of Valparaiso the temperature of the current has been found to be 53°; on the parallel of Coquimbo it was 57°; on that of Cobija, 64°; on that of Arica, 65°; off Pisco it was 66°; on the parallel of Lima, 66°; on that of Truxillo, 69°; and on that of the cape of Blanco, 74°, the eastern limit of the current; and 66° on the western limit.

On leaving the current a little North of Cape Blanco, after a few hours the temperature of the sea was found to be 9° more than the temperature of the current.

The rate of the Humboldt Current is very variable, as it meets with other currents. In general its rate is greater near the coast than out at sea, as is the case with all those that flow along the coasts of continents, a circumstance observed by Humboldt. The minimum rate of it, by the *Bonite*, from Valparaiso to Payta, was three miles; the maximum is twenty-six miles a day. The first was found between Cobija and Callao; the other between Callao and Payta. The *Venus*, from Valparaiso to Payta and the Galapagos, found the minimum rate to be six miles, the maximum twenty-six miles a day: the first on the parallel of Arica; the last between Valparaiso and Cobija. Humboldt concludes from these observations from Valparaiso to Coquimbo, and principally from Arica to Lima, that the rate of this current is from twelve to fourteen, and even eighteen miles a day.

When the Humboldt current runs N.W., suddenly leaving the coast, in the latitude of Cape Blanco, its general rate is about eight miles a day, and the mean rate of it, from these observations, was about fifteen miles a day.

The importance of this current to navigation may be easily understood for vessels from South to North. They make the run from Valparaiso to Callao in nine or ten days, and from Callao to Guayaquil in four or five days. On the contrary, it requires weeks and even months to make the return voyages, especially if the coast is kept, when the route is often impracticable.

Equatorial Current of the Pacific.—The southern limit of the Equatorial Current is considered nearly on the parallel of 26° S.; its northern limit, with some modification, is on the parallel of 24° N. Thus the waters of the Pacific Ocean, in a zone comprising 50° of latitude (nearly one-third of the distance between the poles), have a regular motion towards the West. However, within the limits of this zone and a little North of the equator, a stream of water flowing from West to East, which would appear to separate the whole Equatorial Current into two,—one North and the other South. This counter-current, which is in a great measure caused by the Equatorial Currents themselves, traverses the whole of the Pacific Ocean from West to East.

The rate of the Equatorial Current varies considerably. It has been found setting from thirty to fifty and nearly sixty miles a day. Its mean rate is from twenty-four to twenty-five miles a day. In considering this current generally it will be better to take it in its two divisions, as it is separated by the equatorial eastern stream abovementioned, and we shall first refer to the Equatorial Current of the Southern hemisphere.

South Equatorial Current.—The South Equatorial Current is first experienced on the meridian of 90° W. Its southern limit is just to the northward of the southern tropic of Capricorn, and South of Pitcairn Island; thence it flows westward, nearly along the parallel of 26° S., as far as the meridian of the Tonga Islands.

Near this archipelago the current becomes separated into several branches; one of which has received the name of Rossel: its influence is felt on the South coast of New Guinea and in Torres Strait. The current is tolerably steady among the several groups of islands in this part of the Pacific Ocean, even during the N.W. monsoon.

Another branch of the South Equatorial Current runs along the eastern coast of Australia and as far as Tasmania, forming the warm Australian current, known as the counter-current of the South Pacific Ocean.

Between the parallels of 20° and 10° S. it is found that the mean temperature of the South Equatorial Current varied from 76° to 78° between the meridians of 107° and 122° W.; it has been observed to be 79° to 81° between the meridians of 122° and 137°. Near Tahiti it has been found to be 82°. On the meridian of 188° and the parallel of 8° S., it has been found to be 84°, which is its maximum in the southern hemisphere.

The temperature of the sea out of the current has been estimated at 67°, that is from 9° to 18° below that of the Equatorial Current of this hemisphere.

Rossel Current.—The Rossel Current is a continuation of the South Equatorial Current, and was first noticed by Admiral Rossel in the voyage of D'Entrecasteaux. It receives the name when West of the Tonga Islands, or about North of the island of Tongataboo. Its northern limit is South of the archipelago of the Fejee Islands. It runs to the N.W. and the N.N.W., at about fifty or sixty leagues East from the archipelago of the New Hebrides. It then passes to the northward of the island of Vanikoro and South of Santa Cruz, where it continues flowing West, and is lost South of the island of San Christoval, one of the islands to the S.E. of the Solomon Islands.

The southern limit of this current, the volume of which increases in proportion as it is further West, is to be found nearly on the parallel of 25° S. It then flows W.N.W.. passing southward of New Caledonia, where another branch of the Equatorial Current turns to the S.E., joining the warm current of Australia, flowing along the eastern coast of this continent.

The chief direction of the Rossel Current is W.N.W. and N.W.

Its temperature is 78°. It is found as far as Torres Strait, and has an average rate of from eight to ten miles a day. Its maximum is about eighteen and its minimum four miles.

Current of the East Coast of Australia.—Along the East coast of Australia there is a general current and a periodical current.

The general current of this coast—a branch of the Equatorial, or rather a continuation of it—only takes that name on the parallel of Sandy Cape and on the meridian of 167° E. Its direction is S.W. as far as about 30° S., and it continues along this parallel to 480 miles from the coast. South of the parallel of 30° S. its direction is nearer S.S.W., and it becomes more southerly in proportion as it approaches Tasmania.

Its extent from the coast is about 300 miles on the parallel of 30° as far as the southern extreme of Tasmania, where it divides into two branches The least, which flows round Tasmania, returns along the West coast of that island to the N.N.W. The other, flowing S.E., meets the cold waters flowing to the northward from the southern latitudes, and, taking an easterly direction, forms a part of the counter-current of the Pacific already mentioned.

The temperature of the Australian Current on the parallel of Port Jackson is 64° at its easten limit; 70° in the middle; and 68° near the coast.

This temperature rapidly decreases to the southward. For instance, on the parallel of Bass Strait it is 60° at its East limit, and the direction here is S.W. South of Tasmania the temperature was found to be 54° or 56°, and the temperature of the adjoining sea in this part 51° and 49°.

The maximum rate of this Australian Current is nineteen miles a day, and its minimum about six miles.

Besides the general current abovementioned, there is yet near the coast what may be considered a periodical current.

Lieutenant Jeffries, who was a long time on this coast, shows that from the parallel of 28° to the South part of Tasmania during their summer, that is, from the month of August or September to April or May, the current runs S.b.W. at a rate of quarter of a mile an hour, but not further than twenty-one miles from the shore. Beyond this distance from the shore, and even to about sixty miles, it runs N.b.E. at a rate of three-quarters of a mile an hour. In winter the foregoing currents are reversed.

It follows from the foregoing that the navigation along the East coast of Australia, according as a vessel is bound northward or southward, will depend upon the season; and, according to those circumstances, she should keep near to or at a distance from the coast. A vessel, however, compelled to keep the coast on board in order to profit by the periodical current, requires to be managed with much circumspection and great attention should be paid to the indications of the barometer in case of a gale, in order to keep off the land. It must not be forgotten that it rises at this part of the coast with S.E. winds and falls with those from N.W., as we have before remarked; winds from N.E. and S.W. seem to have no influence on it.

Northern Equatorial Current.—About the meridian of 126° W. long., and on the parallel of 29° N., the North Equatorial Current becomes apparent. Its northern limit continues nearly along this parallel to Loo Choo Island in 127° E. But as soon as it reaches West of the Sandwich Islands, it diverges so considerably towards the South, as to be found in this part near the parallel of 19° N.; sometimes it is found still further South.

The temperature of the Northern Equatorial Current is about 74° at its northern limit, 77° on the parallel of 20° N., 82° on that of 10° N.; near the equator in the East part of the Pacific Ocean, it is 82°, at the middle 84°, to the West and North of New Guinea 89°, the maximum temperature of the Pacific.

In this northern division of the Equatorial Current some remarkable anomalies are found. Thus, between the parallels of 10° and 5° N. lat., and particularly between the meridians of 115° and 150° W. long., is found the eastern part of a counter-current, called the Equatorial counter-current, flowing eastward. This current is sometimes further East, according to Johnstone. In the voyage of the *Bonite*, in 1836 and 1837, it appears that from the 21st to the 30th of August, 1836, between the parallels of 4° 55′ and 11° 8′ N., and between the meridians of 100° and 107° W., currents were found varying from N.N.E. to E.N.E. from three to thirty-four miles in twenty-four hours. This current, perhaps, is not always found in this zone. Commander Hanet-Clery, on the 9th of April, 1846, in lat. 10° 21′ N., and long. 150¾° W., found a current running S. 42° W., at a rate of 25·4 miles per day. On the 11th of April, in lat. 6° 7′ N., and 146¼° W. long., the current was running N. 61° W., at a rate of 20 miles per day; and on the 13th of April, in 1° 17′ N., and 146¼° W., the current was setting S. 58° W., 38 miles per day.

Capt. Wilkes shows that the origin of the Equatorial counter-current is found in the Indian Ocean. According to his views, the current which flows along the western coast of Australia, in the Indian Ocean, is a detached branch of this current. After it has turned the western coast of Australia it makes for the Pacific Ocean by the straits formed by New Guinea and Mindanao.

The eastern equatorial current, traces of which are found near Marshall and Gilbert Islands, separates, according to Capt. Wilkes, the northern from the southern equatorial current, and traverses the whole breadth of the Pacific Ocean. The following statements seem to confirm this opinion of Wilkes, and are of importance to ships making a passage from West to East in the Pacific.

Capt. Hunter shows that a ship can make her way to the eastward in the Pacific without going round South of Australia. He says, the whalers generally follow this route while the S.E. monsoon prevails South of the equator; that is to say, from the end of March or the commencement of April to December or January, they keep North of the South equatorial current and on the limit of the general winds and monsoons. We may refer the navigator to Capt. Hunter's own words on this subject in our May number, p. 250.

These facts amply confirm the existence of a counter-current more or less considerable separating the North equatorial from the South equatorial current. But it has been found over nearly the whole extent of the Pacific by different navigators, as the following extracts will show.

Lutké, in the East part of the Pacific, found currents flowing East, N.E., and S.E., principally in this last direction, between the equator and the parallels of 8° and 10° N. The mean direction of these currents was E. 6° S., and the rate twelve miles per day.

In the West part of the Pacific Ocean, near the Carolines, in spite of the strong winds from N.E., the same captain found a S.E. current in 8° N. and 163° E. To the West of this the easterly current does not extend beyond 7° N., and its southern limit was in 5° 30′ N. Between these two parallels to the meridian of 152° E., during a voyage of twenty-one days, (in January,) he did not meet once with a westerly current; but, on the contrary, often met with an easterly current with a tendency to the southward. North of lat. 6° 30′, on the meridian of 152° E., he found a strong current setting West: to the West of this, in 144° E. and to the southward of 7° N. lat., he again found an easterly current. South of the parallel of 5° N., and on the meridian of the island of Ualan, the current was setting strong to S.W.; but on the parallel of 3° N., it was again found flowing East at a rate of thirteen miles a day.

Other seamen have also mentioned an eastern equatorial current both in the West and the eastern part of the Pacific. Wilson found it in the Caroline Archipelago, extending more to the southward than described by Lutké. Duperry, between the parallels of 2° and 6° N., being from 7° to 10° East of the meridian of the island of Oualan, found a S.E. current, as well as another to the N.E. But in nearing this island he found it setting strongly to S.W. Again, between the equator and the parallel of 8° 30′ N., and the meridians of 148° and 133° E. he found it running East.

Krusenstern places the southern limit of the eastern current near the equator, and its northern limit near the parallel of 6° N. Freycinet met with strong easterly currents between the parallels of 9° 20′ and 4° N., and the meridians of 149° and 144° W. long. Beechey found between the equator and the parallel of 4° N., on his way from Tahiti to Sandwich Islands, a current setting N.N.E. at a mean rate of eighteen miles per day.

Capt. Wendt, of the *Princess Louisa*, between the parallels of 6° 30′ and 10° 30′ N. and the meridians of 125° and 131° W., found a N.E. current flowing from seventeen to twenty-five miles per day. All these currents flowing East are necessarily connected with each other, and enable us to trace the eastern or counter equatorial current on the chart.

Krusenstern says, in speaking of this current, flowing from West to East, that it extends over the West part of the Pacific Ocean in a zone between the equator and the parallel of 6° N., and that it sometimes attains a rate of sixty miles per day. Ships returning from China in the S.W. monsoon, and entering the Pacific Ocean by the straits of Yamen, generally pass no further East than the Pellew Islands; but if they do not pay great attention to this eastern current they are carried several degrees by it in this direction. They should therefore cross it rapidly from North to South, so as to reach the S.E. Trades as soon as possible, and get into South latitude, where, near New Guinea, a westerly current will be found, sometimes W.N.W., at a rate of fifteen to forty miles per day. This important counter-current should receive the attention of navigators, with a view to add their observations to the foregoing, so that its limits may be traced where they are yet unknown, for it may extend across the entire Pacific, which as yet is not absolutely determined.

Easterly Currents West of the Sandwich Islands.—To the West of the Sandwich Islands, and nearly in their parallel, easterly currents are found, which Johnstone calls "the entanglement of the eastern current."

This fact is clearly shown by the observations of some Prussian navigators. Besides, Freycinet speaks of it, Beechey mentions it, and Lutké has collected numerous observations which prove the existence of these easterly currents in a zone where the Trade winds blow with the greatest force. Savans have endeavoured to find the reason of this anomaly in the North equatorial current. We shall see from observations on temperature that what has been considered as a disturbance of the equatorial current, is in reality only the Japan Current, similar to the Gulf Stream of the Atlantic Ocean. We shall first refer to the currents produced by the monsoons of the Caroline Islands while we are in this part of the Pacific Ocean; but it is worthy of remark that the *Bonite*, in 1836, from the Sandwich Islands to Manila, and running between the parallels of 18° and 19° N. lat. to Luconia, found no easterly current here, from which we conclude that in this part of the Pacific, West of the archipelago of Hawaii, the northern limit of the equatorial current is nearly on the parallel of 19° N., and that it is North of this parallel that easterly currents are found.

Currents of the Caroline Islands in the Monsoons.—In the zone of the North equatorial current, and near the western limit of the Pacific, a remarkable independent current is found, known by the name of the monsoon current of the Carolines.

The monsoons of the China Sea, as already observed, exert their influence as far as the meridian of the Marianne Islands and over that of the Carolines. In this part of the sea the Trade and S.W. monsoon alternately prevail. The result is a corresponding current, which especially in the West part of the Caroline Archipelago attains a very considerable velocity.

These monsoon currents of the Carolines appear to occupy a zone comprised between the meridian of Bonnebey on the East and Gilolo Island on the West, extending from the parallel of 10° or 8° N. to the equator.

From June to October the current runs N.E., varying to E.N.E. From October to May it runs S.W. and W.S.W. The mean rate, however, is not more than two or three miles a day. The temperature of their waters varies from 85° to 89°, which last temperature is found very near the equator, in 135° E., the maximum of the waters of the Pacific Ocean. Notwithstanding these monsoon currents, the equatorial current prevails West of the Marianne Islands, a little South of the South parallel of the Carolines, and does not appear to be influenced by the monsoons.

In this part of the Pacific, its southern limit, which flows W.N.W., passes about 120 miles South of Guam, (one of the Marianne Isles,) and at the same distance North of Ouluthi Island, (one of the Carolines,) from thence the equatorial current, the northern limit of which is near the parallel of 26° N., becomes narrower in proportion as the strait of Formosa is approached. At 120 leagues East of this island it suddenly turns northward, and then N.E., and forms the great Japan Current.

Japan Current.—From the island of Loo-Choo, 140 leagues off the eastern coast of China, a continual warm current flows along the East coast of Japan, in an E.N.E. and N.E. direction, often with considerable velocity. It would appear to be occasioned by the accumulated waters of the equatorial current returning to eastward. Its influence is felt as far as the N.W. coast of America, thus, nearly crossing the whole ocean from West to East, it appears to form the Gulf Stream of the Pacific.

The western part of the northern equatorial current having passed from the eastward South of the Loo-Choo Islands, curving round to the N.E. then becomes the Japan Current, continuing its easterly course to the eastward of the Japanese Islands to the meridian of 180°. From thence it runs E.N.E., crossing the parallel of 30° N., on the meridian of the Sandwich Islands; and again running N.E., crosses the meridian of 150° W. in 40° N.

From thence it takes a S.E. direction, curving to the South and S.W. on the parallel of 32° N. lat., and on the meridian of 133° W., where we fail in tracing it further.

The Japan Current, after flowing along the eastern coasts of these islands, and only as one current, gradually spreads itself, and in the latitude nearly of the middle of Niphon Island, forms into two branches, one flowing North-eastward in the direction of Behring Strait, is called the Kamtschatka Current, to which we shall allude presently; the other continuing East, as abovementioned, preserves its name of the Japan Current; its northern limit appears first to continue to the eastward, and is found in 160° E. and 41° N., and in 165° W. and 44° N. From thence turning to the North-eastward, it becomes lost near the N.W. coast of America.

The rate of the Japan Current varies very much. On the parallel of 36½° N., its direction has been found N.E.b.E., with a mean rate of ten miles a day. From 36° N. to that of 35° N., at seventy leagues from the coast, its direction is E.N.E., and its rate forty-eight miles. At twenty-five leagues from the coast, in the same latitude, its rate is seventy-two miles. King also assures us that in these latitudes he found it running at the rate of five miles an hour.

However, according to these observations, as well as those of Broughton, it may be said that generally the rate of the Japan Current near the coast of those islands is a mile and a half to two miles an hour in July, August, and September, and that its rate depends on the distance from the coast. It is also of course influenced by the monsoons which prevail in those latitudes, and it must be observed that in those parts in November it becomes more northerly, and in July more easterly.

Between the lat. of 21° and 42° N., and the meridians of 178° and 163° E., its direction has been found principally East and E.N.E., its rate varying from ten to seventeen miles a day. But between 40½° and 37° N. lat. and the meridians of 162° and 133° W., its general direction was N. 50° E., and its rate from sixteen to eighteen miles a day.

In 21° 20′ N. lat. and 163° W. long., on its southern limit, where it comes in contact with the North equatorial current, the temperature of the Japan current was 77° to 79°, that is, about 4° above the temperature of the equatorial current at its northern limit in this part of the Pacific Ocean. In 27½° N., and 177° E., the temperature of the current was 81°. It then gradually decreased to the northern limit of the current, and in 43° N., and 162° E., was 55°. On leaving this current the temperature falls to 53°, and as far as Kamtschatka is between 51° and 49°. This shows that the sea near the coast of Asia is comparatively warmer; and confirms the assertion that in those parts it never freezes, notwithstanding the cold that is found there.

On a return voyage to Monterey, in again crossing this current the following observations are made:—In 45° N. lat. ,and 164° W. long., beyond the current at its northern limit, the temperature is found to be 52° and 54°; on the northern limit of the current 50°. In 43° 30′ N., and 161° W., it is found to be 64°.

The temperature of the current gradually falls to the eastward. In 36° N., on the parallel of Monterey, and 128° W., the temperature of the current almost mingled with the waters of the current of California, and found to be 61°. Thus in a space of 55° of longitude the falling of the temperature of the waters of this current is nearly 20°, as it flows towards the American coast, between the parallels of 27° and 36° N.

By the foregoing it appears that the warm Japan Current crosses the whole of the North part of the Pacific Ocean, and is felt as far as the N.W. coast of America. This fact is mentioned by all navigators who have crossed this part of the Pacific. They speak of a current flowing East and E.N.E., and attribute it to the prevailing winds varying from N.W. to S.W. These winds without doubt partly contribute to form this current; but its temperature above that of the adjacent sea does not admit of their being the cause of it. Besides, this current clears up the well known fact of the easterly currents, which many navigators have mentioned, to the westward and in the latitude of the Sandwich Islands, a fact which has not been accounted for until now. Moreover, it explains the cause of Fleurieu's whirlpool, to which we shall shortly allude.

Current of the Coast of Kumtschatska.—The Kamtschatka Current, as before said, is a branch of the Japan Current, flowing N.E. and N.N.E. along the Asiatic coast towards Behring Straits. It separates from the Japan Current on the meridian of 150° E., and on the parallel of 38° N. Its eastern limit passes West of the Aleutian Islands, and also West of St. Matthew and St. Lawrence. From there it continues up through Behring Straits into the Frozen Ocean, in a N.W. direction, N.E. on the coast of America, and North in the middle of the strait.

Kotzebue, in Behring Straits, found the rate of this current from one mile and a half to two miles an hour. M. de Tessan found in the latitudes of Petropaulovski a rate varying from seven to ten miles a day in an E.N.E. and N.E. direction.

Behring Current.—Behring Current appears to be formed by the surplus waters carried to this strait by the Kamtschatka Current not finding a sufficient outlet by this strait. It may also originate from other causes besides, and sufficient observations are not yet collected to show whether this is a warm or a cold current.

This current flows from the straits of the same name principally in a S.S.W. direction. In proportion as it reaches to the southward it increases so as to envelope the whole chain of the Aleutian Islands, and is found very strong in the channels formed by them. Its eastern limit follows the N.W. coast of America; its western limit from Behring Strait passes East of the Isles St. Lawrence and St. Matthew; and to the southward a little West of the most western of the Aleutian Islands.

Southward of Behring Strait the temperature of this current is 47°; N.E. of the Aleutian Islands, 47° also; S.E. of the same islands, 51°; near the Aleutian Isles and S.W. of them it was 49°. The maximum of its rate in the same part was nineteen, its minimum five miles, and its mean rate was about fourteen miles a day.

Fleurieu Whirlpool.—"In the eastern part of the Pacific Ocean," says Johnstone, "there is a singular phenomenon, which I have named Fleurieu Whirlpool, because this learned hydrographer was the first who mentioned it in his account of Marchand's voyage. It sets from East to West, and appears to turn in a direction similar to that of the hands of a watch, from left to right, or as the course of the sun appears in our hemisphere. The radius of the irregular figure which it describes, approaching that of a circle, is nearly 240 miles.

"It occupies the space comprised between the parallel of 25° and that of 40° N. lat., and the meridians of 133° and 155° W. long. It is found near the North limit of the Equatorial Current, and also near the commencement of this current, in the eastern part of the Pacific Ocean.

"As Lutké crossed it and did not deny its existence, it may be regarded as probable."

It is sufficient to glance at the accompanying chart of the currents to perceive that the supposed whirlpool is no more than that apparent rotatory movement produced by the South limit of the Japan Current at its eastern end and the northern limit there of the Equatorial Current.

Cold Current of the American and Californian Coast.—Along the N.W. coast of America South of Cape Tshirikoff, and along the coast of California, a cold current is found, setting principally to the southward and along the indentations of the coast. It varies in its distance from the coast, but may be generally considered as 300 miles across. When it reaches the coast of Lower California it turns more westerly in proportion as it reaches further South. At Cape San Lucas it runs nearly W.S.W. and loses itself in the North Equatorial Current.

The temperature of this current appears to increase rapidly in proportion as it is found near the equator. On the parallel of Monterey it was 57°; on that of 30° it was 59°; and on that of Cape San Lucas, 72°. The rate of it is about fourteen or fifteen miles a day. The maximum is twenty-two miles, and its rate is greater near the coast than out at sea, and it is most at the entrance of the Gulf of California.

Current of the West Coast of Mexico.—In concluding this view of the general currents of the Pacific Ocean we have only to allude to the periodical current of the Mexican coast,—an occasional current caused by the monsoon which prevails there. Humboldt is the first who mentions it, and Basil Hall and Beechy have since contributed observations on it.

The Mexican Current extends from Cape Corrientes northward of Acapulco to the Cocos Islands. Its outer or western limit is about twenty leagues East of those islands, which are in the counter-current found near this limit. This current follows along the coast of Mexico, with a breadth of nearly 360 miles, and has a counter-current in the opposite direction at its inner limit, close in shore. From December to April the course of the Mexican Current varies from S.E. to E.S.E. From May to December its direction is changed, being from N.W. to W.N.W., and its rate depends on the strength of the monsoon by which it is occasioned. Its importance to the navigation of the coast will be readily perceived.

The following table gives a general view of the currents of the Pacific, showing the mean rate of each from different voyagers.

Comparative Table of the Mean Rates of the Currents in Twenty-Four Hours.

South Pacific Ocean.

South Equatorial Current		24 miles.
Counter-Current of the Pacific Ocean		20 ,,
Current of Cape Horn		18 ,,
Humboldt Current		15 ,,
Mentor Current		16 ,,
General Current of Australia		12 ,,
Periodical Current of Australia	off the coast	6 ,,
	out at sea	16 ,,

North Pacific Ocean.

North Equatorial Current	30 miles.
Counter Equatorial Current	15 ,,
Monsoon Current of the Carolines	3 ,,
Japan Current	31 ,,
Cold Current of the American and Californian Coast	16 ,,
Kamtschatka Current	8 ,,
Behring Current	14 ,,

Currents in Behring Straits and the Arctic Coast of America.

The following remarks on the currents of Behring Strait and along the North coast of America, made by Mr. John Simpson, Surgeon of H.M.S. *Plover*, in the August of 1852, may not perhaps be deemed useless, as they will tend to correct the erroneous views given in some of the most authentic current charts of these regions lately published. The main streams only have been alluded to, without noticing the eddies and counter-currents of local and temporary existence.

Through the large opening between the American and Asiatic continents, occupied by the Aleutian Islands, there is an almost imperceptible set from the Pacific Ocean northwards, the waters of which, retaining the impulse given to them by the earth's rotation in a lower latitude, draw towards the American shores and throw themselves into Norton Bay. They are thence driven with increasing force along the coast line of America, opposite the island of St. Lawrence, diffusing themselves to the northward of that island to be carried with lessened speed through the strait of Behring,* after receiving in the latter part of their course the fresh water stream falling through Grantley Harbour into Port Clarence. Spreading again over a larger space they receive a further tribute from Kotzebue Sound, which is very palpable off Point Hope. Again, in the latitude of Icy Cape the earth's rotation gives them an easterly set, forming an almost constant current along the North coast of America to Point Barrow, whence it pursues a direction N.E. Throughout all this course the current is subject to retardations, and even surface drifts in an opposite direction, caused by northerly and north-easterly winds; but it is also occasionally accelerated by S.W. and westerly gales.

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* The strait of Behring is here understood, in its restricted sense, to be the interval between the East Cape of Asia, and the Cape Prince of Wales of America, in which are situated the Diomede Islands. Between these and the island of St. Lawrence is understood to be Behring Sea; and South of the last named island, with Norton Sound or Bay on the one side, and the gulf of Anadyr on the other, is the sea of Kamtschatka.

The compass points mentioned are true not magnetic.

In the absence of actual observations for determining the currents in these seas, the proofs of the existence of such a one as that described are collected from other circumstances, the chief of which are as follow:—

In the beginning of summer the eastern side, South of the strait, is free from ice, and Norton Bay itself is usually cleared as early as April. After the middle of June not a particle of ice is to be seen between Point Spencer and King Island, whilst the comparatively still water North of St. Lawrence Island is hampered with large floes until late in July. This can be satisfactorily accounted for by the existence of a northerly current of warmer water, partly driving and partly thawing the ice from the American shores.

There is scarcely a particle of driftwood to be had on the Asiatic coast from Kamtschatka to East Cape, whilst abundance is to be found in Port Clarence and Kotzebue Sound, as well as along the whole of the American shore from Norton Bay to Point Barrow. Although it has been found that pine trees sixty inches in girth grow here, on the banks of American rivers, within the sixty-seventh parallel of latitude, yet from the frequently larger size of the trunks and their great abundance, it is evident these northern regions, including Norton Bay, cannot supply the quantity; and more southern rivers, whether Asiatic or American, or both, must be looked to for the immense multitude of water-worn stems and roots strewed almost everywhere along the beach. Their southern origin would also seem to be indicated by the presence in many of them of the remains of the *teredo navalis*, which could hardly retain life throughout the rigour of eight or nine months' frost every year. Captain Wellesley mentions having picked up on the North side of the entrance to Port Clarence, a buoy which had been previously lost from the anchor of the *Dædalus* off the island of St. Lawrence.

It would seem that between St. Lawrence Island and the coast of Asia the current is variable and seldom entirely free from ice until late in July, hence the many disasters to whalers in 1851, and the difficulties the *Dædalus* and *Enterprise* encountered the same season by taking the western passage, whilst an open boat from the *Plover* was able, between the 17th of June and the 1st of July, to make the run to Michelowski, in Norton Bay, and back without her crew seeing any ice. The *Amphitrite*, in 1852, was able to reach Port Clarence on the 30th of June, by the eastern passage, without seeing but one floe, which had probably been recently released from some of the nooks of Norton Bay, although late in the same month the master of a whaling ship reported that the ice was still fast as low as latitude

58° and 60° between the longitude of Gore Island and the coast of Kamtschatka.

From the recorded observations beginning with Captain Cook, continued by Captain Beechey in the *Blossom*, Captain Kellett in the *Herald*, Captain Moore in the *Plover*, Commander Pullen in the *Plover's* boats, and again by Commander Maguire in boats this season, 1852, it appears that the coast from Icy Cape to Point Barrow is frequently packed with ice in the end of July and the beginning of August. The cause of this seems to be the occasional presence of westerly and north-westerly winds, which drive the pack upon the coast, again to be cleared away by the North-East current along shore as soon as these winds have spent their force; and southerly and S.E. winds will have the opposite effect of driving it in a more northerly direction and leave the navigation more open than usual.

At Icy Cape the current on Captain Beechey's chart is marked as running both ways along shore, but not, it is presumed, with the regularity of a tidal ebb and flow. During the continuance of an easterly gale, from the 29th of July to the 4th of August, and a fresh breeze for two days following, at that cape, floating substances were observed to drift slowly to leeward, whilst the waves were short, irregular, and much more broken than usual, to a distance of twelve miles off, as if caused by a weather current; this may, however, be partly owing, for half that distance, to the shoals extending four miles off the land. On the 3rd a whaling vessel stood in to within six miles of the shore, tacked, and stood out again, making such progress to windward as a sailing vessel could only do when favoured by a strong weather current.

From Icy Cape to the Seahorse Islands in addition to driftwood there is strewed along the beach a quantity of coal, which, though much water worn, may, in some of the indentations, be collected in sufficient abundance and bituminous enough to make an excellent fire for cooking. It is of the sort called glauer or candle coal, and some of the pieces are sound enough to be carved by the natives into lip ornaments. At the Seahorse Islands it is found as fine as small gravel, and on digging into the beach is seen to form thin alternate layers with the sand; but between Wainwright Inlet and Icy Cape it is gathered in knobs of a convenient size for fuel. This may be taken as a further evidence of the set of the current, as the nearest known point whence the coal is brought is that marked on the chart as Cape Beaufort.

The whole extent of coast from below Icy Cape to Point Barrow is bordered by a beach of gravel, which has likewise a southern origin, and determines the form of the continent, offering as it does an effectual barrier to the encroachments of the sea, which would otherwise speedily undermine the earth cliffs behind. All that can be seen from the seaboard, landward, is a flat alluvial plain, seldom exceeding twenty feet in elevation, and containing numerous pools or lagoons of fresh water; but without a tree or bush to relieve the view.

The tides are hardly appreciable and very irregular at Kotzebue

Sound and Port Clarence. Then, the sea usually retains a very low level during the prevalence of northerly, north-easterly, and easterly winds; and the highest levels occur with southerly and south-westerly gales. During a stay of seven days at Icy Cape, with a prevailing gale at East and E.N.E., the same low-water level obtained as much as four feet and a half below the highest surf mark, the undeniable effects of westerly and S.W. winds. With the drifted material left on those marks where the shore has a westerly aspect were several varieties of dead shells, identical in species with those previously dredged from the bottom of the sea in deep water (twenty-five to thirty fathoms) in the straits and North of them. If, as is presumed, these were deep sea shells they would afford further proof of the easterly set of the current, as the waters of the sea are not agitated by the most violent storms to such a depth; and if their habitat be equally in shallow water, it is difficult to imagine why they are not found in equal abundance on those parts of the shore exposed to North-easterly winds.

As far as Icy Cape this coast current is less than that sweeping thence to Point Barrow, and there is reason to believe the increase is derived from the waters on the North coast of Asia, where the loss may possibly be supplied from that portion of the Gulf Stream that flows towards the North cape of Europe. Standing on Point Barrow it may be seen that the body of moving water is broad, and soundings have shown it to be also deep. Its mean speed is certainly not less than one mile an hour in a direction nearly N.E., but it is of course a matter of mere conjecture to what distance it follows that course, though Davis Strait may be assumed as its probable outlet.

NAVIGATION OF THE PACIFIC OCEAN.

From the Atlantic the Pacific Ocean is entered either by the West after doubling Cape Horn, or by the East on doubling the Cape of Good Hope. In this latter case the Indian Ocean must be crossed to reach the Pacific, and one of the numerous straits adopted which connect the two seas; or the course South of Australia.

In continuation of the subject of the routes for crossing the Atlantic as well as the Indian Ocean, those for the Pacific by the East or West are here explained according as the ship is bound to the eastern coasts of Asia, Australia, or a port in the western Pacific, or whether that may be in its eastern part on the coast of America.

These remarks will be followed by those on the principal routes for crossing the Pacific Ocean, and from which others may be easily deduced.

It will be convenient to divide the subject into,—

1st.—Routes from the American ports to China and Australia and back; also routes from India or China to the East coast of Australia and back.

2nd.—Routes from India and China to Australia by Torres Strait, with instructions for its navigation, and the eastern coast of Australia and back by Torres or Pitt Straits.

3rd.—The navigation of the western coast of America.

First Part.

From the West Coast of America to Manila or Macao.—There are two great routes from the western coast of America to Manila or Macao, or any other point of the southern coast of Asia, that may be taken according to circumstances or the object of the voyage: they are called the great Southern and Northern Routes.

Great Southern Route.—The great southern route is taken only by ships from the southern ports of America. These also often prefer the northern route.

Vessels from Chiloe, Lima, or Guayaquil bound to China or Manila, on leaving the coast generally run direct down the S.E. Trade for the archipelago of Nouka Hiva, and afterwards pass South of the Gilbert Archipelago and northward of the Pellew Islands. Beyond these islands the route then depends on the state of the monsoons in the China Sea.

In the S.W. monsoon the strait of San Bernandino is generally adopted. In the N.E. monsoon ships pass North of the Philippines, through the Bashees and between Formosa and Lucon.

An essential point when bound to Macao is that the coast must be made in a latitude according to the monsoon. If a ship make it only one degree too much North or South, or in other words, if she be 1°

of latitude to leeward of the desired point only, the voyage may be delayed for several weeks.

It may be observed also respecting this route that it is most advantageous from March to October, the period when the S.E. Trade winds blow over the whole extent of the ocean; while from October to February variable winds from West and S.W. prevail, accompanied by bad weather. The most favourable time for leaving the American coast for this route is from February to July. The same route also will lead to Australia, if, after having passed West of the archipelago of Nouka Hiva, a course be steered so as to pass East or West of Samoa, Tonga, and the Fejee Islands, or between these different groups. From them a course for the desired port of Australia may be shaped.

Again, if bound to China, the above route may be modified thus:—The course will be followed South of the equator to the meridian of 164° West. From thence the course is changed to N.W. to pass North of the Gilbert Islands and then between the Mulgraves and the Ralick Islands, passing these last to the South, and attaining 13° or 14° N. lat., then steering West to pass South of the island of Guam, so as to make a straight course for the strait of San Bernardino. This strait must be entered cautiously, for its entrance is very narrow and beset by strong currents and eddies, the effect of the tides. Having cleared this strait, the China Sea is entered by the strait between Mindoro and Lucon, and the monsoon is then fair for the port. In this route should a vessel pass between the Marianne Islands, this may be done boldly, for all the channels between them are safe.

From North America to China.—The passage from the North American coast to China is made in the N.E. Trades, and is adopted by vessels from ports North of the equator, and very often by those also from ports South of it.

In this route those calms must be avoided, met with in the southern hemisphere near the numerous islands scattered about, and which calms considerably lengthen the voyage, and the difficulties also of the passage, occasioned by the uncertain position of islands, which are not yet well determined. This route, moreover, is always the best for vessels from ports North of the equator, and most favourable during the months from July to February.

Where to Cross the Line.—On leaving the American coast a vessel should make direct for the N.E. Trade. Coming from the southward she would cross the belt of the equatorial variables, and it would be best to do so between 117° and 132° W. By the table in chapter i. it will be seen that the zone of these variables is generally less in winter and spring in the northern hemisphere than in summer and autumn; and hence the course may be shaped so as to profit by this information to reach the N.E. Trade as soon as possible, for when they are well established they are stronger than those from the S.E.

In the passage from the southern to the northern hemisphere the vessel will have to cross the equatorial counter-current already mentioned, and which sets strongly to the East and E.S.E. in about 4° or 5° N. This must be crossed as quickly as possible, and the N.E. Trade will be generally found between the parallels of 5° or 6° N. when the sun has a South declination, or between those of 9° and 10° N. when it has a North declination.

Once in the N.E. Trades, should a ship intend touching at the Sandwich Islands, she would steer directly for them, making them on an East bearing on account of the current. From these islands she would steer West, keeping between the parallels of 13° and 15° N., where a fresh Trade is more certain than in a higher latitude, and she would keep this course until gaining the meridian of the Marianne Islands.

A vessel not touching at the Sandwich Islands should keep on the parallel of 12° or 13° N., profiting by current and wind. If the latter be weak she has only to run about half a degree more to the northward to find a fresher breeze, a measure she can always adopt when necessary. In this run a ship may keep her old sails bent, but from the meridian of those islands westward it will be prudent to change them, for now she will meet with strong northerly winds, varying to N.E., with a heavy sea.

From the Marianne Islands, according to the monsoon which prevails in the China Sea, a course more or less to the northward will be shaped according as necessary. While the N.E. monsoon prevails in the China Sea, and in the neighbourhood of the Marianne Islands strong northerly breezes are found, the current runs southward, for which allowance must be made in order to keep for the channel South of Formosa to enter the China Sea; so that in running between the Marianne Islands the channel between Assomption and Grigan should be taken; or even to pass northward of the archipelago in order to secure reaching the strait so as to round the Bashee Islands to the northward, allowing for the current, which in this strait often runs S.S.W. with northerly winds. As already observed, bad weather is frequently found in this channel.

At the time of the S.W. monsoon the strait of San Bernardino should be taken, and the course should be previously shaped for it.

The foregoing route is nearly that which was followed in former days by the Spanish galleons from Acapulco to Manila. Those vessels left Acapulco so that they might reach the Philippines before the month of May, the time when the S.W. monsoon commences among these islands; and they returned from Manila in July. In going, they generally touched at the Sandwich Islands, and from them steered for the Mariannes, anchoring at the island of Guam; and from thence they steered for Samar.

Return Route from India or China to the American Coast.—To return from India or China to the coast of North America it is highly important to start while the S.W. monsoon prevails, as it extends so far over the Pacific as the environs of the Marianne Islands, affording thereby the means of making a quick passage. A vessel should therefore leave Manila or the ports of China towards July, and having gained the parallel of 34° N., should keep it, running East with the Japan Current and the general westerly winds of these parts, which appear to be nearly as constant as the Trade winds, and to which the name of the westerly Trades has been given. These winds will take her to the coast of California. If bound to a port more to the southward than California, a course should be shaped accordingly, taking care to cross the N.E. Trades obliquely.

China or Manila to South America.—Vessels from China bound for the coast of Peru or Chili should adopt the foregoing route. They should then cross the N.E. Trades obliquely till they reach the S.E. Trades, and should cross these, running well to the southward, so as to get South of the parallels of 28° or 30° S. as soon as possible, and reach the temperate zone of this hemisphere, where the prevailing winds are westerly; with which they may soon reach their destination.

With the N.E. monsoon, in the China Sea, it will be very difficult to follow the above route. It will be very trying to get North of the N.E. Trades into the westerly winds, and doing so will render their passage much longer than if they had sailed in the S.W. monsoon.

Vessels bound for South American ports, leaving the China Sea in the N.E. monsoon, make the voyage in southern latitude, where there is much danger, arising from the numerous islands and coral banks in that part of the Pacific.

In mentioning the equatorial counter-current we have shown the route taken by Captain Hunter from West to East in the Western Pacific, when he found the S.E. monsoon established there. Those remarks are applicable to return routes from China and Manila to ports situated in the Eastern Pacific, and consequently are applicable to the case before us.

It has also been shown, from the observations of Captain Hunter, that the South equatorial current seldom extends beyond the parallel of 2° N. Consequently, at the time when the easterly monsoon prevails in this part of the Pacific, a vessel can have no difficulty in getting to the eastward by keeping near the equator, and in finding near it the zone where there is no current, and where the counter-current is flowing eastward. Besides, near the equator, during the S.E. monsoon in the southern hemisphere (from March to December), there are variable winds, hanging to the westward. Thus, ships from the Philippines, Timor, or islands West of the latter, in order to reach ports of the Pacific, when they leave those islands in the first part of December or January, should generally make a good quick passage if they reach North of the Moluccas Channel (Gilolo or Dampier) between the 15th of December and the 15th of March, when the S.W. monsoon is blowing in those parts.

At all other times the direct route for getting to the eastward will be available, provided, as above said, that the ship keep North of the South equatorial current and the zone of the monsoon, that is, by keeping near the equator.

During the westerly monsoon the wind generally hangs to the northward and N.W. about the Cape of Good Hope of New Guinea. East of this cape fresh westerly winds are found, with an easterly current of two or two and a half miles an hour. This current, extending between the coast of New Guinea and the equator, runs through the Caroline Archipelago, and without fear of losing the breeze or the current a vessel may pass near the islands of St. David and North of Providence for whichever passage may be preferred to cross the archipelago, and steer southward after gaining the West winds of the temperate zone.

The eastern part of Dampier Straits, although the most direct for a vessel going to Sydney, is not the safest. The best route for reaching the St. George Channel will be to keep the equator until the meridian of the Admiralty Islands be gained; then to steer S.E., so as to pass between this group and St. Matthew: a route by which the low islands and reefs may be passed without fear during the night.

The other route, North of the Solomon Islands, appears to be the best for vessels going to New Zealand, the Feejee Islands, or otherwise to the eastward.

A ship bound to New Zealand should not cross the parallel of 10° S. before reaching the meridian of 170° or 172° E. She would then run to the southward along the western side of the Feejee Islands, keeping near them, for the easterly winds extend very far South during the months of January, February, and March; and, provided she passes to windward of the reefs off the South point of New Caledonia, she may keep this route for the southern zone of variable winds.

Having reached New Caledonia or New Zealand, a quick passage may be made to the coast of America with the assistance of the westerly winds found South of the parallels of 28° or 29° S.; which, indeed, in some degree, may be considered as general winds, from their prevailing in those parts. It is not unlikely that this route will eventually be generally taken by vessels in all seasons from China or Manila to South America, especially when they have good charts of the Western Pacific.

Port Jackson or Tasmania to America.—The latter part of the above route from China to the coast of America during the N.E. monsoon may be also adopted for going from Port Jackson or Tasmania to South America or for Europe by Cape Horn.

Several vessels have made the passage from Port Jackson to Staten Island in forty-six days. Freycinet in thirty-eight days made the passage from Tasmania to Cape Horn,—being from December 29th to February 4th,—by running between the parallels of 48° and 58° S.; and, with the exception of a single day, when the wind was from S.E., during the whole of the voyage they varied from N.N.W. to S.S.W. by the West. The currents constantly flowed to East and N.E. at a maximum rate of seventy miles in twenty-four hours, and never less than four, but at a general rate of twenty-two miles a day.

When this route is taken for passing Cape Horn it must not be forgotten that summer is the most favourable season for leaving the Pacific, and principally during the months of January and February, although this passage is in general so easy and short that it may be taken at all seasons of the year.

It may be observed on this subject that small vessels, if they choose, have the advantage of using the strait of Magellan for leaving the Pacific Ocean, especially since the charts and directions for it have been so greatly improved. But at the same time, if they do so, there must be, says Captain King, a decided advantage to induce the navigator to decide on taking a succession of channels while he has an open sea and a fair wind before him. On leaving the strait of Magellan, the winds being westerly, and generally either North or South of West, they are favourable for coasting; and, in case they should not be, a ship is not exposed, as in the outer route, to a heavy sea,—so inconvenient to a small craft,—for near the American coast the sea is comparatively still. But the ship which has doubled Cape Horn, if the wind is from N.W., should run East of the Falkland Islands, and is there exposed to heavy breezes and a violent cross sea; in addition to which to make northing a ship is obliged to keep her wind, which exposes her to heavy and dangerous seas. Hence, it would certainly appear that there is a decided advantage for small vessels to adopt the passage by the strait of Magellan.

The principal routes here defined are sufficient to give a general idea of the mode of crossing and recrossing the Pacific. According to the port of departure and destination, the route can be modified.

From India to East Australian Ports.—From routes given in the work on the Indian Ocean it will be easy to decide on that to be taken from India to Port Jackson. There are, however, yet two to be mentioned: one, the North route to Torres Strait, which should be taken from the beginning of September to the end of March, the period of the N.W. monsoon in these latitudes; the other, the southern route, by rounding Australia to cross Bass Strait, is taken from March to September, when the S.E. monsoon prevails in Torres Strait.

In the southern route from any port in the northern part of the Indian Sea the principal object is to gain the Trades as soon as possible, to cross them quickly by an oblique route, approaching the western coast of Australia, and then run along the South coast to Bass Strait.

From the Cape of Good Hope, a ship crossing the Indian Ocean would take the same route as that for China by the Great Eastern Passage. By the Great Eastern Passage, to which we allude a ship may enter the Pacific, first, by passing South of Tasmania; second, by crossing Bass Strait.

Passing South of Tasmania.—When taking the route South of Tasmania, often dangerous and longer than that by Bass Strait, a vessel from the westward would run on the parallel of 39° S.; when in 130° E. long. she would steer so as to pass South of Tasmania to gain the meridian of 144° E. before making the land, and being cautious not to fall in with it at night, by anticipating the effects of current or any error in the reckoning by drift or otherwise. When rounding the South cape, unless a vessel is bound to Hobart Town, she should keep at a distance of at least twenty-four or thirty miles from Cape Pillar and the eastern coast of the island, so as to avoid the variable winds and calms, which will otherwise place a vessel in an awkward position, while out at sea there is a good breeze. This is particularly necessary during summer, when easterly winds are common and on the eastern coast of Tasmania, as well as Australia, there is a N.E. current of about a knot an hour, extending out to twenty leagues from the land; but within seven leagues from the coast a counter-current to this sets in the opposite direction at about half that rate.

Route by Bass Strait.—A vessel intending to enter the Pacific by Bass Strait, having gained the meridian of about 135° E., should keep on the parallel of King Island, to avoid being set to leeward by the S.E. wind, which should always be guarded against in the bay West of Cape Northumberland; as well as being set to the southward by the strong N.N.E. winds always met with West of Tasmania between the parallels of 40° and 44° S.

Coming from the westward for Bass Strait, the coast of Australia should be avoided, being dangerous with southerly winds, and affording no sheltered anchorage against them. The S.W. and southerly winds must be specially guarded against, and during the period when they prevail a vessel should not be to the northward of the parallel of 40° S. until within forty leagues of King Island.

If the wind has a tendency to veer northerly and circumstances be favourable for sighting the coast before night, it will be better for a vessel entering the strait, and uncertain as to the land, to steer so as to reach the coast on the meridian of 143° E. On this meridian there are several high white rocks, forming a considerable projection on the coast, and there appear to be no dangers near them at a distance of a mile and a half or two miles from the land.

The western entrance of Bass Strait is between the islands near the N.W. point of Tasmania and Cape Otway of Australia. It is thirty-six leagues wide, with King Island nearly in the middle, and occupying about twelve leagues of it. North of this island is a passage fifteen leagues across; and another to the South only twelve leagues wide, in which there are many dangers, and is only taken in a case of necessity.

Approaching the strait from West a vessel should endeavour to sight the land about Cape Otway, the lighthouse on it rendering it very remarkable. Should the weather prevent this the vessel may know she is in the direct route for the strait by having soundings of sixty fathoms, grey sand. The same depth with a rocky bottom will show her to be too far South and off the West coast of King Island, with its rocky and very dangerous coast.

A vessel certain of her position at the entrance of the strait should steer for Curtis Island, which is seen from the deck in fine weather at a distance of ten or eleven leagues. The distance from the entrance of the strait to this island is forty or fifty leagues, and, as there are no dangers in the way, with a good look-out part of it may be run over during the night. Passing South of Kent Group at a distance of six miles or more from Deal Island, which is the largest, an E.N.E. course may then be shaped or that course adopted nearest to it, according to the prevailing wind, so as not to get too far to the northward near Long Reach.

The foregoing are the directions of Captain Flinders; since they were drawn up, the channel South of Kent Group has been found so full of rocks, difficult to make out even in fine weather, that the best route to follow is that between Kent Group and Wright Rock or between Kent and Hogan Groups, leaving Curtis Isle to the northward. The Crocodile Rock, between this island and the isle of Medondo, is thereby avoided.

The tides off Wilson promontory are too rapid to render it advisable to approach it without a strong breeze. In the event of a S.E. gale, the position of a ship in its neighbourhood would be no less bad after having weathered the chain of islands at the entrance of the strait as after having cleared one of the channels more to the southward.

Anchorages in Bass Strait with the East winds.—The most convenient places for anchoring in the strait when bound eastward, are:—

1st.—Franklin Bay, on the N.W. point of King Island, sheltered from the sea by the New Year Islands, and where there is tolerable protection from easterly winds.

2nd.—Port Phillip. The anchorage is just inside the entrance on the South side of the port: with a favourable wind a vessel can leave it with the tide, which is very strong.

3rd.—The Hunter Islands, where a vessel should anchor between the Three Hummocks and Hunter Island, taking care not to be too near the weather shore, in case the breeze should suddenly change.

4th.—The bay between Wilson Promontory and Cape Liptrap; to be adopted only in case of necessity, for it is an unsafe anchorage, particularly with S.W. winds, which blow strongly.

5th.—Kent Group; convenient for small vessels, which may anchor in one of the little sandy bays East of the islands.

6th.—Furneaux Group, anchoring between Clarke and Preservation Islands. A vessel leaving this anchorage, if she cannot double Clarke Island and obliged to pass S.E. of it, when the wind admits should cross Armstrong Channel, sending a boat ahead to keep her clear of dangers. The entrance of the strait between King Island and Hunter Group should not be generally taken, on account of the several rocks in it. A ship obliged to cross it should pass South of Reid Rock; keeping near the black pyramid with it N. 53° E. will clear the Bell and Conway Rocks. With a steady fair wind a ship may pass between King Island and the Reid Rocks; in which case she should keep near the shore of the island, and allow for the current which sets strongly across the strait. But Reid Rocks always break.

From China to the East Coast of Australia.—Leaving Canton in the S.W. monsoon for the East coast of Australia, the shortest route in general is the eastern one. Entering the Pacific by the strait of Formosa, a ship would then make her way eastward and cross the

N.E. and S.E. Trade winds obliquely, and so as to find herself East of the port of Australia to which she was bound, then gaining its parallel. This route has no other difficulties than those common to navigation amongst scattered islands of the Pacific.

The same route, on the contrary, will be dangerous and more tedious in the N.E. monsoon, for the strait of Formosa must be left for the Pacific, working to windward in order to gain easting and northing through the N.E. Trade winds, for the variables North of 30° N. lat. On leaving the strait of Formosa a vessel should always take the shortest route for clearing the Trade winds. In general, a ship should gain as far as 165° E. before going South.

During the N.E. monsoon, namely, from September to February, instead of taking this route it will be more advantageous to keep in the China Sea; by which bad weather will be avoided and a quicker voyage made. After passing East of the Great Natuna, the Carimata Channel would be taken, and then the East point of Madura would be steered for, the ship passing between the islands of Pondy and Galion if intending to take Bally Strait. Lombock, however, is better and so is Allas Strait. Having cleared the straits, the ship would work in the Indian Ocean, profiting by the changes in the wind, which at this season are generally from S.S.W. to S.S.E. between the northern limit of the Trades and the eastern straits. Westing must then be made to cross the Trades for the variable winds of the Southern hemisphere, with which easting will be rapidly made. In March and April Bass Strait may be taken, or by preference the route South of Tasmania, on account of the easterly winds which prevail in the strait during these two months. In all other months Bass Strait should be taken as the shortest route.

From East Coast of Australia to India, Southern Route.—Leaving Sydney or ports on the East coast of Australia for India or Europe, a ship may take Bass Strait, or round the South coast of Tasmania, if she does so between the commencement of September and the 1st of March. In January, February, or March S.E. winds are found near Tasmania more commonly than in any other month. These winds may be advantageous to make westing, but it is necessary to keep at a good distance from the Australian coast, so as to profit by every change of wind and not to be thrown ashore by a breeze from S.W., which is frequent at this season.

Vessels going to Europe have also taken this route during the winter months of this hemisphere (June, July, and August); it is true that bad weather renders it very disagreeable, but not impossible to adopt even in this season.

As soon as possible the ship should gain the zone of the Trade winds of the Indian Ocean, and having done so should take the proper route for her destined port. The passage is made under favourable conditions from Sydney to Bengal in two months; vessels have occupied fifty days on the passage from Sydney to False Bay, and it is in the summer months, October, November, and December, that the best passages are made.

Passage of Bass Strait from East.—The entrance of Bass Strait is the space comprised between Wilson Promontory and the N.E. cape of Tasmania. Between these two capes there are a great number of islands of granite rock, forming a chain extending about forty leagues.

The winds are generally favourable for the passage of the strait from East to West and for coasting in January, February, and March. Easterly winds are seldom found at any other time; they come in squalls, and generally end in a breeze from the opposite direction, having much of the rotatory character. The gales of the strait commencing at N.N.W. draw gradually to and end at S.W. If the wind at West before having become S.W. returns to the northward of West, the squalls will still continue; but this the barometer will perfectly indicate. It seldom clears up when the barometer falls to 29·9 in., and bad weather is certain when it marks 29·65.

We may here observe that during the three months abovementioned when the passage of Bass Strait from East to West is the easiest, it is dangerous (not to say impossible) for sailing vessels to adopt Torres Strait, nor will it be of much advantage to a ship to be in Bass Strait before the middle of December. Indeed it would be better not to be there before the middle of January.

A ship leaving Sydney or any other port on the East coast of Australia, should make Cape Howe her point of departure, and should not steer West of S.S.W. until she is in 39° 33′ S. lat., on account of the dangers she may meet from S.E. winds near Long Beach.

Having gained lat 39° 30′ S., she may then steer nearly W.b.S., leaving the Sisters Rocks, Craggy, and Wright Rock to port (southward). She will then sight Deal Island, the easternmost of the Kent Group, which in fine weather can be seen from the deck of a ship ten and even twelve leagues distant. In daytime she should steer for this island, and in the night for the revolving light which is on it, and which may be seen at a distance of nearly twenty-six miles. She would pass three or four miles South of this island, then continuing westward she will sight successively the other islands of the group to the southward, and pass at the same distance from them. She would proceed in the same manner with respect to Curtis Island and the Sugarloaf Rock, which will now be in sight. From Curtis Island to the northern extremity of King Island, the route is nearly W.b.S., and the distance forty-two leagues. No danger exists in this part, nevertheless it is preferable to steer so as to pass, if the wind permits, five or six leagues North of King Island. If it be from West to North, she may safely steer for Three Hummock Island, and pass either North or South of King Island, according as convenient. She would look out, however, for three small islands seen by the French corvette *Géographe* in lat. 39° 53′ S., about thirteen leagues East of Sea Elephant Bay,—but these islands appear to be doubtful.

Anchorages in Bass Strait with West Winds.—In case of contrary winds, if the weather be bad, and S.W. winds set in blowing strong, there are several anchorages where a ship may wait for a change. The best are these:—

1st.—The bay West of Erith Island, one of the Kent Group.

2nd.—Hamilton Road, at the eastern extremity of Preservation Island.

3rd.—Off the South coast of the largest of the Swan Islands (convenient only for small vessels) and Waterhouse Island.

4th.—Port Dalrymple.

5th.—Port Sorrel, accessible only to small vessels.

6th.—Several bays in Hunter Group.

7th.—Sea Elephant Bay, on the East coast of King Island, where fresh water may be had. The anchorage is under the N.E. point of the island with the wind at S.W.

8th.—Western Port, sheltered by Grant Island, where the ship should anchor as soon as within the entrance: when the wind is good for passing the strait, this will allow of her making sail and leaving it readily.

9th.—Port Phillip.

The ports abovementioned affording shelter only from certain winds, and these being very variable in Bass Strait, a ship should be always ready to get under sail so as to leave them directly it becomes necessary.

The navigation of Bass Strait demands prudence and caution.

North Route by Torres Strait.—From March to September passages from Sydney to Bengal, as well as to ports in the eastern islands, may be made by Torres Strait. In this route the ship should make to northward along the coast of Australia as far as Sandy Cape, and then should take the *Inner* route. A ship taking the *Outer* route on leaving Sydney should adopt the most convenient course for the meridian of 155°, and steer so as to pass West of Howe and Middleton Islands. She would then make to the northward, taking care to avoid Wreck Reef, the Bampton, Minerva, Bellona, Ball, Kenn, and Frederic shoals, among which Lamb and Bass Islands are passed. These banks and islands are situated between the parallels of 24° and 20° S. lat. Allowance must also be made for a N.W. current of at least a mile an hour. When Wreck Reef is passed, a course should be steered so as to pass sixty miles East of Diana Bank, from whence Torres Strait may be entered.

Navigation of Torres Strait.—Route from India to the East Coast of Australia.—The navigation of Torres Strait, one of those which connect the Indian with the Great Ocean, has for some years acquired great importance, and the number of vessels which take this route increases annually. It will be useful, therefore, to collect and combine all the instructions given for this navigation in the *Nautical Magazine* in such a manner as to tell seamen as completely as possible what to do in this strait. The following appears in the directions of Captains P. King, Blackwood, and Yule, who have made charts of these dangerous latitudes. As already said in the Indian routes, Torres Strait may be often taken with advantage. It was long thought that during the N.W. monsoon it was impossible to pass through this strait, but the surveys of Captain Blackwood have shown that this was erroneous.

Passing from the Indian into the Pacific Ocean by Torres Strait, a ship arrived off Cape York can take either of two routes for ports on the eastern coast of Australia. By the first, called the "Inner Route," the coast is followed from Cape York to the rock called Breaksea Spit, which stretches to the northward from Sandy Cape. The second, the "Outer Route," commences from the Barrier Reefs North of Darnley Island by Bligh Passage or by those North and South of Raine Island. By a vessel outside of the Barrier Reefs the route in a former page may be taken in reverse: that is, passing East of the Diana Bank, between Albert Reef, left to the West, and the Mellish Bank, left to the East, a course is steered so as to pass East of Kenn Reef, Wreck Reef, and the Cato Bank, to the parallel of Sandy Cape, South of which the sea is free from all danger.

Ships bound to India from a port on the East coast of Australia by Torres Strait take either the inner route up to Cape York, or the outer route for Bligh Channel or those of Raine Island. Opinions differ on the advantages of these two routes in respect to the time of passage. The outer route may be preferable, but, under all circumstance, the inner route is generally considered as the safest, and is particularly recommended by the late Admiral P. P. King, who surveyed it. Captain Blackwood, who surveyed the outer edge of the Barrier, says regarding it:—

"It appears to me that the Inner Route of Admiral King ought always to be taken by a steamer, because the time lost in anchoring the first five or six nights will be amply made up for by the rapid passage that she will make in the day in calm waters of this sheltered route. The distance from Cape York to Sydney being only 2,000 miles, a steamer would probably make it in fifteen days, even allowing for foul winds near Sydney during the winter.

"With a sailing vessel from the westward I should recommend leaving Torres Strait by Bligh Passage, North of Darnley Island, that has been recently explored by the *Fly* and the *Bramble*. It has the advantage of offering everywhere sufficient depth for anchoring, and there are no coral banks under water.

"I do not think that when the usual precautions in this kind of navigation are adopted any accident can be met in taking the Raine Island Passages, especially if the new charts made by the *Fly* and the *Bramble* are on board (No. 1749). This passage has the inconvenience of bad anchoring ground in the space between Bird and Raine Islands; nevertheless, it is the shortest route with regard to distance."

Opinions are still more divided on the question of which is the best route to take for Torres Strait from East, that is from the Pacific to the Indian Ocean, or from Sydney to India. But there can be no doubt, if a rapid passage is to be made, that in the height of the S.E. monsoon (from May to September), the passage by Raine Island or by Bligh Channel, North of Darnley Island, cannot be accomplished in half the time required for the same purpose by the inner route. But yet the first routes are those generally taken by trading vessels.

A steamer will have the great advantage of being able to take the inner route for Torres Strait during the westerly monsoon (November to March), a time when it is scarcely practicable for sailing vessels, and I think in all cases the best for a steamer to take is the inner route, because she can find wood all along the Australian coast. There does not seem to be any reason for the passage from Sydney to Singapore occupying more than five weeks, for certainly the S.E. Trade will be found as far as 14° or 15° S. lat., where westerly winds will then be found.

The following remarks of Captain Blackwood will be useful, as presenting a general view of the navigation of Torres Strait:—

Torres Strait is generally more frequented by vessels passing from East to West than by those from West to East. For some years past, however, many commanders have taken this route, at the risk of delay on the passage. Thus, we may observe, the westerly monsoon, which prevails in the seas of the Indian Archipelago from November to March, inclusive, is not regular in Torres Strait. It is only found there occasionally, in intervals lasting from eight to ten days, about the changes of the moon. In some rare cases these westerly winds are tolerably strong, though they are generally variable, and only appear to be interruptions of the S.E. Trade winds. These breezes should be met with in November and in the following months as far as March, and sometimes even, but seldom, in April. For steamers, however, the wind is of little consequence, and in Torres Strait it is seldom strong enough to delay them.

On the N.E. coast of Australia and in the neighbouring sea the easterly Trade wind prevails nearly all the year. From May to September it is mostly from between E.S.E. and S.S.E., both strong and regular. During the rest of the year it becomes moderate and more northerly, sometimes from E.N.E. and N.E. In January, February, and March, at the changes of the moon, the gusts from N.W. are of short duration, as before said. Sometimes there are strong breezes at this time, although generally these winds are moderate and bring fine clear weather.

On the eastern coast of Australia, between Moreton Bay and Sydney, westerly winds prevail from May to September, the winter time of the southern hemisphere. The wind is often strong in this season, but as it is off the land the sea is smooth and navigation is easy. In the summer months the wind is generally from the eastward, assuming almost the character of a Trade wind.

The currents of this coast are much influenced by the Trade winds. The current coming from the eastward is divided at Breaksea Spit. One part of it flows N.W. towards Torres Strait, and the other turns South along the coast until it reaches Cape Howe, where it joins the body of water coming from Bass Strait, driven there by westerly winds, and then the whole of it flows eastward towards the South coast of New Zealand.

Routes from India to Torres Strait.—A ship from Madras or Calcutta intending to take Torres Strait, having crossed the gulf of Bengal, would stand along the West coast of Sumatra, and then steer for Torres Strait, passing South of the Sunda Islands. If she is from Singapore or China she will probably find Allas Strait the best route for passing South of the Sunda Islands to Torres Strait, for at two miles from the coast of Lombock there are good anchorages (that of Peejou, among others) on the western side of that strait. On leaving Allas Strait she would steer so as to pass South of Sandal-wood and Rottie Islands, keeping at a good distance from the latter in order to avoid the Sahul Bank, some parts of which are dangerous. Rottie Strait is safe, although Captain Law has mentioned a danger there that should be avoided by keeping on the North side of the strait. From the South point of Rottie she may run direct for Wallis Islands, at the West entrance of Endeavour Strait, taking care to avoid several coral banks mentioned by Captain Flinders, and since examined by Captain Blackwood.

Captain Mackenzie, on the contrary, says that vessels leaving India or China for Torres Strait would do well to take the Java Sea, and make their way North of the Sunda Islands out of it, between Ombay and Pulo Cambing. During the two monsoons, he says, the water is smooth in the Java Sea and among the Moluccas, compared with that which is found South of the Sunda Islands and in the Sea of Timor, on account of the swell from S.W. always prevailing and very trying. Besides, sailing vessels by keeping in the Java Sea will have the advantage of the land breeze off the North coast of the Sunda Islands. On leaving Ombay they should steer directly for Torres Strait.

Again, vessels from India should take the strait of Malacca for Singapore, and from thence the Java Sea. Crossing this sea, they should leave it by Ombay Strait, or by passing between Timor and Wetta, for the Timor Sea to Torres Strait. This is a route especially advantageous for steam-vessels.

Steam Routes from Singapore to Sydney.—This opinion of Captain Mackenzie is confirmed by the following directions (from the *Nautical Magazine)*, which complete what we have already said about the navigation of the Java Sea. To proceed from Singapore to Sydney by the Java Sea and Torres Strait either one of two routes may be adopted, known by the names of the South and North Routes. With the exception of the strait between Salayer and Celebes, in the northern route, and the passages between the islands East of Madura (Pondy, Galion, Hog, Kangelang, and Urk), in the southern route, the channels in either of them are not so narrow as to render navigation dangerous by day or night. Besides, by leaving Singapore early a vessel would reach the strait of Salayer by daylight. But the best time for leaving Singapore is at eight in the evening, and, having cleared the harbour, an E.b.N. course for Pedra Blanca should be steered.

Pedra Blanca (thirty-two miles from Singapore) is an isolated rock, about twenty feet high, near the middle of the eastern entrance of

Malacca Strait. The principal channel, situated North of this rock, is four miles wide in the narrowest part.

A lighthouse, named after Horsburgh, the tower of which is stone and seventy feet high, is established on Pedra Blanca. The light revolves once a minute, and is visible from the deck of a vessel distant fifteen miles.

From Pedra Blanca the course is nearly S.E.b.E. for about 315 miles, to the Carimata Group; in which distance the depths vary from twenty to twenty-five fathoms, with a muddy bottom.

Carimata Passage.—The Carimata Group (347 miles from Singapore) are in the entrance of the channel formed by Borneo and Billiton, and generally known as the Carimata Passage. The track most frequented in adopting this passage is that which leads South of Souroutoie, the channel between this island and Ontario Reef, being little less than twenty miles across, When Carimata Peak bears about N.N.W. a S.S.E. course (keeping the peak still N.N.W.) leads nearly in the middle of the channel, between the Mancap Rocks, which extend beyond the S.W. point of Borneo, the reefs which line the eastern side of the strait, and those which bound the western. The depth of water in this track is over eighty feet, with a muddy bottom. In clear weather the East island of the Montaran Group is visible, and as the peak of Carimata is also within view a vessel can always determine her position.

Having crossed the Carimata Passage, there are two routes for proceeding eastward, which join at Pulo Cambing, an island on the North coast of Timor. According to the season, each of these have their advantages.

The Southern Route during the East Monsoon.—During the easterly monsoon (from April to September, inclusive), the southern route along the North part of the islands East of Java ought to be taken by steamers. At this time, when Bally is passed, a current will be found setting eastward at the rate of a mile to a mile and a half an hour.

The Northern Route during the West Monsoon.—The northern route by Salayer Strait has the advantage of being a little shorter (about thirty miles), besides during the westerly monsoon, which lasts from October to March, squalls of wind and heavy rain are met near the islands East of Java, whilst more northerly the weather is comparatively fine. The northern route then is preferable at this period, and should be taken by a steamer whether bound East or West.

Southern Route in the Java Sea.—Having cleared the Carimata Passage, if the southern route is adopted a course for Bavian Island or Lubeck should be shaped. Then, should Bavian Island be gained during the night, the ship should steer for Pondy (an island a little East of Madura), so that by daybreak she may pass between this island and that of Gilion or Galion. But if Bavian be reached before night, the best course to take is for the N.W. point of Kangelang, so as to stand on without fear during the night, and then take the passage formed by this island and that of Urk. These two passages are well known and much frequented. The passage between Pondy and Galion Islands is generally taken by vessels which enter the Java Sea by Bally Strait, in going to Singapore or China. It is also taken by Dutch vessels taking coffee to Banyn Wange before returning to Europe.

As soon as the islands East of Madura are passed, the route during the four following days will cross the space which separates the continent of Asia from that of Australia. As soon as the N.W. point of Sumbawa is gained, a course should be steered to get into 8° S. lat., and keeping on this parallel the ship may run East, a course which will clear all danger as far as Ombay Strait, where the southern route in the Java Sea rejoins the northern one, which, as we have before observed, crosses Salayer Strait. The peaks and headlands in the above route are very remarkable. The eastern peak of Lombock is seen at a considerable distance and is one of the best marks for vessels passing northward of the islands East of Java. The northern shores of these islands are generally bold, for no soundings are known off them for a mile out to sea. The dangers shown on several charts off the North coast of Lombock and marked as doubtful, have in vain been several times searched for by Dutch cruizers, so that it may safely be said they do not exist.

Northern Route in the Java Sea.—Leaving the Carimata Passage for the northern route in the Java Sea, and bound eastward, a course should be steered for the Solombo Group (782 miles from Singapore). The principal island, the Great Solombo, is nearly twenty miles in circumference. It is a singular formation, being high with a flat summit. Passing South of this island, at about ten miles distance, an easterly course should be followed for Point Layken, the S.W. point of the Celebes, and arrive abreast of Bonthain Mountain. The middle of the channel should be kept between Milieu and South Islands in Salayer Strait, so as to pass North of the Mansfield Bank, on which in some parts there are only 3 fathoms water.

In Salayer Strait the most frequented passage is that between Milieu and South Islands; it is four miles wide and clear of danger. The other channels through the strait are not sufficiently known.

Eastward of this strait and among the Moluccas, the West monsoon is the period of the fine season. In fact, this archipelago is subject to frequent fogs and squalls, brought by the East winds from the Pacific, between April and September inclusive.

Having passed Salayer Strait, an easterly course should be steered, until the high peak of Kambyna is to the N.W. Then S.E.b.E. will lead direct to Ombay Strait, between Pulo Cambing and Ombay Island. The only land near this route is Hagedis or Lizard Island. It is flat, well wooded, and from the deck of a vessel may be seen at a distance of twenty or thirty miles. The passage from Hagedis to Pulo Cambing will occupy about ten days.

The island of Pulo Cambing or Passage, (1,520 miles from Singapore by the South, and 1,490 by the North route,) is very remarkable.

It is bordered by steep cliffs, at the foot of which in some parts there is a narrow beach of sand, and in the middle of it a peak 2,000 feet high. There is no anchorage off this island.

The channel between Pulo Cambing and Ombay is eighteen miles wide; that between Pulo Cambing and Babi is eight wide; both are safe, and either may be taken as convenient. The channel between Wetta and Timor is wide and also safe, and although along the shores of these two islands are outlying rocks here and there, no soundings are to be found within a quarter of a mile of them. The shores of both are very high, and as there is generally in the day towards noon a thick fog lying over the sea, they are easier made out in the night.

Jacki Island is low and bordered by a reef. The passage between this island and the N.E. point of Timor, is narrow but safe, and anchorage may be had in the strait near the Timor coast.

Kissa Island forms with the eastern extremity of Timor a channel eighteen miles wide, which is quite safe, as well as between Jaki that and Jetti Islands.

The Java Sea may be entered by one of these channels that is most convenient.

A vessel from the Java Sea may steer direct for Torres Strait, unless desirous of sighting Cape Wessel, which, however, is not necessary. The soundings and latitude are sufficient for reaching Torres Strait, and these decrease gradually as the strait is approached. With regard to the latitude, it is found that with the westerly monsoon, in which only the sun is clouded, if the weather is bad during the day, it is fine in the night, and *vice versâ.*

For the first two hundred miles after leaving Timor, the lead will not give soundings, but beyond this soundings from 115 to 116 fathoms are found on the Great Australian Bank. These soundings gradually decrease to 8 fathoms on nearing the entrance of Endeavour Strait.

South of the route, and nearly on the parallel of 10° S. lat., there are several coral banks, 7 fathoms being the least depth over them, excepting the Money Bank, discovered in 1841, on which the least depth is 4 fathoms.

The Victoria Rock, the only danger North of the route which leads to Torres Strait, was discovered in 1843, on which there is only 4½ feet water.

Approaching Torres Strait, it will be right to keep out on the parallel of the entrance of Endeavour Strait, that is, between 10° 45′ and 10° 50′ S. lat., so as to avoid some rocks said to exist East of Booby Island, called the Aurora and Proudfoot Rocks. They are between the East longitudes of 138° 37′ 15″ and 139° 3′ 15″, and on the parallel of 10° 33′ S.

Seamen differ in opinion as to whether Torres Strait should be entered by Endeavour Strait or the channel North of the Group of Prince of Wales Island. The latter appears to be well adapted for large sailing vessels: but for steamers Endeavour Strait would appear the most convenient, especially if a coal depot be established at Albany Island as proposed.

Endeavour Strait.—Following Capt. Blackwood's directions now, he says, whatever may have been the route from Singapore or India from the westward for Endeavour Strait, and on the parallel of 10° 50′ S., at a distance of twenty or twenty-five miles the high lands of the Prince of Wales Islands should be seen, extending from N.E. to E.N.E., and when not more than eleven or twelve miles, Wallis Island, and the most northerly, Red Wallis, should be seen from the mast-head, appearing like two small islands, of which the largest is that to the northward. The northern Wallis Island is rocky, nearly one mile in circuit, covered with verdure, and composed of ground and rocks of a red colour, to which it owes its name.

The southern Wallis Island (Woody Wallis) is low, flat, and wooded; the highest trees are on the northern part.

Between these two islands there is a channel five miles wide, which it is not prudent to take, on account of its banks; and for the same reason a vessel should not pass South of the Wallis Islands, or between these islands and the coast.

The soundings become very irregular as the strait is approached, but yet decreasing gradually to 5 fathoms, with a sandy bottom, which is found on the outer part of the bank which extends in a westerly direction six and a quarter miles beyond North Wallis Island.

To avoid this bank, North Wallis Island should be kept to the E.S.E.½E., and when eight or nine miles from the island, a vessel should steer East to pass North of the bank of North Wallis Island, on the western extremity of which there are only 1¾ fathoms of water. When North Wallis Island bears S.E. the depth will be from 5½ to 6½ fathoms. The narrowest part of Endeavour Strait will be passed; Cape Cornwall will then be seen E.N.E. On approaching the bank of North Wallis Island the colour of the water will be seen to have changed, and if there is any sea this will be recognised in the breakers it causes. In case it is necessary to tack near its western extremity, the lead should be kept going, because the channel in this part is only two miles wide and is narrowed to the North by a sand bank, very like the bank of North Wallis Island. This bank, on which the depth varies from 2½ to 1¾ fathoms, begins on the West coast of the Prince of Wales Island and extends westward as far as the end of the bank of North Wallis Island, forming with the northern edge of this bank the entrance channel to Endeavour Strait from the West.

Again, Endeavour Strait may be entered by bringing Cape Cornwall to bear N. 78° E. known by the hill, in the form of a peak, which surmounts the promontory of the Peak.

When North Wallis Island is passed to the southward a course should be steered so as to pass one or two miles South of Cape Cornwall. Endeavour Strait has no hidden danger and no bad holding ground throughout its whole extent. The soundings vary from 6½ to 7½ fathoms over a sandy and coral bottom.

When North Wallis Island bears South, a mile distant, the course is nearly E.b.N. for Entrance Island, distant nearly 15½ miles.

Entrance Island.—Entrance Island, with a high round hill on its end, is West of the Possession Islands, and is the nearest of the Prince of Wales Islands. The passage South of it is perhaps the best by which to leave Endeavour Strait, being two miles wide, with a depth of eight fathoms, a sandy bottom and no hidden danger.

The two other channels, between the Great and Little Woody Island and Whale and Peaked Island, and between these and the two little islands which we find between these two groups, are equally safe although not so large.

Currents.—The currents in these channels often attain a considerable velocity; sometimes five miles an hour with the high tides; the ebb running N.E. and N.N.E., and the flood setting S.W. and S.S.W.

Having passed Endeavour Strait, the course to Cape York is direct and free from danger, and this Cape reached a ship may leave Torres Strait either by Bligh Channel or that of Raine Island.

We will now add Lieut. Yule's directions for passing Endeavour Strait from East to West.

Approaching from S.E., should the ship draw more than 18 feet of water, when she has passed the channel between the Brothers and Albany islands, a look out should be kept for a rock mid way between Mount Adolphus and Cape York, with 3½ fathoms of water on it, and having passed it, should steer for Endeavour Strait, which may be entered by either of the three channels just mentioned. The least depth in either is 4 fathoms, and the most westerly appears the best, because it is larger and has a depth from 8 to 9 fathoms, on a sandy bottom. To take this channel the ship must run West of the Possession islands, the two most westerly of which are close to each other, and thickly wooded. Having passed between these and Entrance Island West of them, the course will be W.S.W. ¼ W. for Wallis Islands, which should be passed about two miles North of the most northerly of them, and when abreast of them, at this distance, the course must be changed to W. ¼ S. for eight miles, or until Booby Island bears N.b.E. Nothing South of this course must be made to avoid the great sand bank which is West of Red Wallis Island, and when Booby Island bears N.b.E. the vessel is clear of Endeavour Strait.

Prince of Wales Channel.—Another channel, less direct, is that of the Prince of Wales Islands passing North of them. This channel, which is well adapted for large vessels, also leads to Cape York. A vessel entering it from West should pass North of Little Booby Island, avoiding the reefs eastward of it, and make the channel formed by the reef *d* and the N.W. reef, and on the other by the Goode, Hammond, and Wednesday Islands to the northward of Prince of Wales Islands. These last being passed, the course is about S.E.b.E. as far as the meridian of West Double Island, then S.E. for Cape York, where either Bligh Channel or that of Raine Island may be adopted.

Bligh Channel.—A vessel taking Bligh Channel from Entrance Island should run about thirty miles on a N.E. course, passing North of the rock *a*, and four or five miles from the Harvey Rocks. The depth of the water in this course is generally from 8 to 9 fathoms, with a bottom of sand, coral, and shells. The Harvey Rocks are 2 or 2½ fathoms above the water and may be approached within a mile on either side without danger,

When Harvey Rocks bear N.W. two miles the course must be changed to N.N.E. and twelve miles run on it to pass through a group of low woody islands called the Sisters, the family consisting of Bet, Suke, Poll, and Nine Pin and Saddle Islands, &c. It would appear that the sea between the Harvey Rocks, Mount Adolphus, the Sisters, and the North coast of New Holland for the space of thirty miles is quite free from danger, so that if it becomes dark, and to anchor is not desirable, a vessel may lie to during the night, keeping a strict look out for the current, and after running nine or ten miles beyond Endeavour Strait in the space above mentioned, tacking every three or four hours.

The Sisters.—The low islands called the Sisters, are separated by channels three or four miles wide, which are all safe. The principal one is between Long and Bet Islands, and may be recognized by having near the middle a small sandy island with stunted bushes on it.

Pass either North or South of this islet, avoiding a bank under water nearly two miles to the eastward, and which is the only hidden danger in Bligh Channel; then a course E.N.E. for Cocoanut Island, the eastern end of which is covered with cocoanut trees. Pass North of this island, and take the channel formed by it with Dove Island, which is low. Having passed North of Dove Island, leaving Village Island to the East, steer about N.E.b.N. in the channel between the northern islands of the strait and the Great Warrior Reef, which here bounds the South coast of New Guinea.

It would be difficult to show clearly the route to be taken amidst this archipelago of wooded islands; but steering N.E.b.N. for thirty-five miles after having left Dove Island, a vessel may sail and take the channels which separate them with confidence, and approach within half a mile of the N.W. shores of these coral islands; for their reefs always grow off their S.E. and E.S.E. extremities.

Having run thirty-five miles on the course abovementioned, in depths from 16 to 18 fathoms, (sandy bottom,) taking care to make due allowance for the set of the tide, Stephens Island will be at hand, and the entrance of the channel will be seen.

Stephens Island.—Stephens Island is known by being higher (160 feet) than the other wooded islands in this part of Bligh Channel, and is separated from the little (Campbell) island by a channel two miles wide, which must not be taken. Campbell Island lies S.W. of Stephens Island.

If the weather is at all clear, Darnley Island, which is 580 feet high, and round, will be seen. In Treacherous Bay, where this island is, good anchorage may be had, with some supplies of fresh water and provisions; besides good shelter from S.E. winds.

Having passed North of Stephens Island, a course nearly N.E.b.E. will take a vessel clear out of Torres Strait by Bligh entrance, bounded on the North by Bramble Cay, on the South by Anchor Cay and the dry sand banks which are to the North and beyond the reefs of Darnley Island.

Having passed Bramble Cay either to the North or South, a course should be steered gradually to gain the parallel of 9° 15′ which passes North of the Eastern Fields and Portlock Reefs. A vessel should run East, then S.E for Cape Rodney at the S.E. part of New Guinea, where, being in an open sea, a course may be taken as desired.

Route from Eastward for Torres Strait by Bligh Channel.—A ship desiring to take Bligh Channel from the eastward or the Pacific Ocean, after having passed Cape Rodney should gain the parallel of 9° 15′ on which to run West. This will take her North of the Eastern Fields, Portlock Reefs, into the fairway of Bligh Channel. The channel would then be followed, reversing the directions already given, and the Indian Ocean entered either by Endeavour Strait or Prince of Wales Channel.

The Eastern Fields and Portlock Reefs.—The Eastern Fields, discovered by Flinders, are a detached collection of coral reefs. Portlock Reef is of the same kind, leaving between them and the Great Barrier a safe channel thirty-four miles wide. In the vicinity of Portlock Reef 55 to 57 fathoms are found, on a coral bottom, decreasing gradually to 45 and 36 as Anchor Cay is approached.

Anchor Cay.—Anchor Cay is a small sand bank situated at the N.W. extremity of a detached reef; Darnley Island is visible from it in fine weather; with another of the same kind, the East Cay, which is nearly three miles E.S.E., it forms the southern limit of the entrance of Bligh Channel in the Pacific Ocean. These two cays are both extended on the S.E. side for a good mile by a reef, and are separated from the northern extremity of the Great Barrier by a safe channel seven miles wide.

Bramble Cay.—Bramble Cay, to a vessel from the eastward, is the best mark for knowing the entrance of Bligh Channel. It is a sand bank 10 feet high, visible from the mast-head seven or eight miles off, and is fringed by a reef, which extends one mile from its E.S.E. extreme. This sand bank is covered with scurvy-grass, and is the retreat of an amazing number of birds. A detached patch of black rocks, ten feet high, lies S.W.b.W. three miles from it, with a safe channel between them, and the rocks may be approached to about a mile.

Darnley Island.—If the weather be at all clear, when a vessel is six or seven miles South of Bramble Cay, Darnley Island should be seen, with its long reef, having a sand bank at its extremity reaching nine miles N.E. from it. North of this reef are three separate detached coral reefs, with safe channels between them, the two southernmost of which dry at half tide. They should be looked for with much care, because they narrow the entrance of Bligh Channel in this part. They always break, but at high water the northern reef is entirely covered, and it is seven miles North of the sand bank at the extremity of the reef, which extends from Darnley Island, or nearly sixteen miles N.N.E. of the island. A vessel entering or leaving Bligh Channel should always pass North of this reef. The channel between it and Bramble Cay is safe, and about fourteen miles wide.

The southern part of the entrance of Bligh Channel, between Bramble Cay and the North reef, should be carefully avoided at night; for there is ample space for a ship to lie to or anchor in 20 fathoms on a sand and coral bottom, in any part of the channel North of Bramble Cay; that is, between the cay and the coast of New Guinea, the nearest point of which is thirty miles from it. We must take care not not to get into less water than 5½ fathoms when approaching the coast of New Guinea, or at a distance of seven or eight miles from land. This coast is low, and can only be seen from the deck from twenty-seven feet.

Tides.—Near Bramble Cay the flood comes from N.E. and E.N.E.; at springs its rate is nearly two miles an hour. The ebb runs faster in the opposite direction. As the flood approaches New Guinea it takes a more northerly direction, and along the coast it runs N.W. and N.W.b.W. A constant westerly current of at least one mile an hour may always be expected when running for the entrance of Torres Strait, and this rate is increased after a gale.

At fifteen or twenty miles from Bligh entrance, the ebb does not appear to have any influence, and the westerly current being the most general, is only felt. Having passed West of Bramble Cay, the flood will be found setting West and W.S.W., then it turns southward, on account of the reef off the South coast of New Guinea.

Towards the middle of the channel, near Dove Island and the Sisters, the flood sets N.W. and the ebb S.E. The rise and fall at springs is not more than ten feet. At Darnley Island the establishment is 9h. 30m., rise ten feet. On the South coast of New Guinea the establishment is 10h. 30m., the rise fourteen feet. At the Sister Islands, in the middle of the channel, the establishment is 11h. At Cape York it is 12h. At Wallis Islands and the western extremity of Endeavour Strait, it is 1h. The tide thus turning two hours later in the channel than on the coast.

From Cape York through the Barrier by Raine Island Passages.—We shall confine our remarks to showing the routes that are taken from Cape York through the Barrier Reefs by the Raine Island Passage instead of Bligh Channel. The first part of this route, as far as Cape Grenville, is the last of that given by King from Sydney to Cape York by the inner route, and we shall continue afterwards his directions, the other part of this route being described by Captain Blackwood, who gives directions from Raine Island to Cape York.

From off York Island a course should be steered E.S.E. South of Mount Adolphus Island and North of the Albany Islands, looking out to avoid a danger between these two islands, with 2¾ fathoms, and leaving the Brothers Islands to the eastward. When the northernmost of these two islands bears East, or the N.W. point of Albany Island West, the course should be changed to S.S.E. ½ E., to pass East of Turtle Island and Shadwell Point; and leaving the reefs Z and X on the East, then keeping the same course nearly, leaving Gilmore Bank to the West, and Cairncross Island to the East, passing between this last and Bushy Island. From thence steer so to pass East and near the Hannibal Islands, leaving to the East several small sand islands, the Boydong Cays, and the W and V reefs, and then passing North or South of the Bird Islands. Then as convenient take the North channel North of the reef and Cockburn Islands, or the Pollard Channel, which is to the South of them. These two channels unite South of the Middle Banks, from whence Raine Island may be steered for.

From Sydney for India.—Vessels leaving Sydney or ports on the East coast of Australia for India, during the S.E. monsoon, (from April to October,) will find it more advantageous to go by Torres Strait than by Bass Strait at this time of year, on account of the strong westerly winds prevailing along the South coast of Australia.

For Torres Strait a ship may take either the inner route of King, within the Great Barrier Reefs and the coast of Australia; or, the outer route, outside of the Barrier.

Inner Route.—When taking the inner route, says Capt. Blackwood, a ship must follow closely the directions of Capt. King, for from the condition of these seas it is possible that steep coral banks may exist close by the tracks where deep soundings appear.

From Sydney to Sandy Cape, where King's directions begin, the navigator has only to navigate an open sea, without dangers. A ship having rounded Breaksea Spit in the evening, it will be dangerous to continue on during the night, and therefore having run five or six leagues N.b.W. ¼ W., she should lie by for the night; if, on the contrary, she is off Sandy Cape in the morning after having rounded Breaksea Spit, the course will be W.N.W. ½ N. about a hundred miles, this will take her about twenty miles from Cape Capricorn. In this route, which passes about three miles inside of Lady Elliot Islet (low) and the southernmost islet of the Bunker Group, the effect of the current will be seen, which will be allowed for accordingly. If it sets North, these islets may be passed on either side.

Having made Cape Capricorn, the shore should be followed at a convenient distance, the course N.N.W. ¼ W., passing on either side of Peaked and Flat Islands, South of Port Bowen. Continuing on for the Percy Group, pass between Nos. 2 and 3 of the Northumberland Group, and having passed No. 3, a dangerous low rock five and three quarter miles N. 16° E. and West of No. 1 island must be avoided. During the night this should be done by keeping near No. 3 of the Northumberland Islands, which is high and steep. The channel on each side of the Percy Islands is safe; but that West of these islands being the best known, should be preferred; then following the route of the *Mermaid* and *Bathurst* along the coast as far as Cape Grafton. If the weather be fine a ship may get as far as this cape by night, but it must be observed that off Cape Grafton the Barrier Reefs approach the coast and contract the channel. Fitzroy Island should be passed a mile distant, and when its northern point bears West, a course N.W.b.N. (or N. 35° W.) should be steered for thirty-five miles, which will take the ship to about a league S.E. of the Low Isles. If they be reached by night, they should not be approached within twelve fathoms. In this route great care must be taken not to borrow to the East, to avoid a rock seen by Tamar (Satellite Rock of the chart). If the weather be fine and the moon up, these islands will be easily seen: but it will always be more prudent to navigate only by day.

In the route abovementioned the depth will be from 16 to 17½ fathoms.

From the low isles abovementioned steer for the Hope Islands, which are N. 16° W., distant thirty-eight miles from them. It is, however, preferable to keep West of this course, to avoid several rocks situated in 15° 51′ S. lat.; Cape Tribulation will then be passed at two miles, from whence shape a course to pass East or West of the Hope Islands. It is best to pass West of the most westerly of the Hope Islands, and follow the reef at about three quarters of a mile round this island, continuing to the northward, and pass East of the little detached rock *a*. When off the northern extremity of this last reef, a course N. ½ W., twenty-eight miles, will lead to Cape Bedford, which may be passed at a distance from one to four miles. In the above route, at three and a half miles from the reef of Hope Island, reef *b* will be seen. At fifteen miles from it the ship will be abreast of reef *c*, and five miles further she will pass Turtle Reef, remarkable for a dry sand bank at its northern part. All these reefs will be left to the East. The current sets N.W. and must be allowed for. In passing along the coast the heights will be observed as marked on chart No. 1076, the high hill like a cone, at the southern side of the entrance of Endeavour River and Cook's Mountain. By bearings, this mountain and the other heights, as well as Cape Bedford, a vessel may make sure of her position, and discover the effect of the current, which is not generally very strong in this latitude, not more than about two miles an hour.

Off Cape Bedford the course is North, and the Three Isles, which are flat and wooded, will be seen ahead. Steer to pass West of this group and East of Low Island, wooded, then steer direct for Cape Flattery which should be passed with a good berth, then for Point Look-Out, so as to anchor West of it near the Turtle Group, unless daylight admits of reaching Nos. 4, 5, and 6 of the Howick Group, near which will be found good anchorage. Point Look-Out must not be approached nearer than two and a half miles to clear a reef marked on Captain Cook's chart. It is one and a half mile North of the peak-shaped hill at the extreme end of the point. The Turtle Islands may be passed on either side or between Lizard and Eagle Island, but it is not advantageous to do so because the wind is much stronger the further from the coast and the distance is ten or twelve miles greater than the other; there is a good anchorage West of the peak of Lizard Island. From the Turtle Islands steer North 55° W. (N.W.b.W. nearly) for the hillock on the S.E. extremity of the island No. 1 of the Howick Group, leaving it to the East, and passing about one mile West of islands 2 and 3 of that group, then between No. 4 and Cole Island, and West of No. 6 island and the sand banks S.E. and West, partly above water. If the day is advanced when abreast of No. 6 of Howick Islands, it would be better to anchor under its lee than to stand on as there is no good anchorage between it and Cape Flinders.

Having rounded Cape Melville Flinders Group will be seen. The end of the reef off that cape bears from it N. 31° W., and Pipon Island about S. 62° W., with a reef round it. Having passed between these two reefs steer direct for Cape Flinders, the North point of West Flinders Island. The course is W. 4° S. (W. ¼ S. nearly) distance nearly twelve miles. In this run a low wooded island and the reefs *a* and *b* should be left to starboard. The *Satellite*, in 1822, touched a small reef nearly two miles E.N.E. of Cape Flinders, but as the cape may be approached almost within a stone's throw it may easily be avoided. The best anchorage under the lee of Cape Flinders is to have shelter of the flat hill upon it; at one mile from the shore the depth is 8 fathoms, a muddy bottom. In passing the cape care must be taken to clear a shoal which extends two cables' length from the shore on its Western side. If daylight favors to run fifteen miles beyond the cape the ship should anchor under the reef *d*. In these latitudes anchorage may be had under shelter of all the reefs or islands between Cape Flinders and Cape Melville; the bottom is of mud everywhere, and anchoring N.W. of the rocks there is sufficient shelter from the sea which is generally smooth.

On leaving Cape Flinders, steer W. 14° N. for twenty-three miles, leaving the rocks *c*, *g*, and *h* to the North, and the rocks *d*, *e*, and *f* to the South, then steer N. 31° W. to pass West of reef *i* and Pelican Island; then East of the Claremont Islands, No. 1 and No. 2, which are low and wooded.

When abreast of island No. 2 of this group the S.W. extremity of reef *m* will be seen, which should be passed distant one or two miles, and steering N. 10° W. the islands No. 3 and 4 of the same group will be reached: pass either to East or West of the island No. 4, the channels being both safe. If passing East of No. 4 steer N. 5° E. to pass near the reef *o*, passing West of this reef and isle No. 6 so as to avoid the low rock, covered at high water, and which lies about two and a half miles N. 64° W. of this island. Passing West of isle No. 4, keep a mile and a half or thereabouts from it, and when it bears East steer N. 13° E. for isle No. 6, passing it West one mile to avoid a sunken rock N. 64° W. from it. Passing this rock steer for isle No. 7, and pass one mile West of it to avoid the dangers which extend East of Cape Sidmouth. From thence steer N. 17° W. for Night Island, and when abreast of it keep North, until near the hidden rock *v*, which should be left to the East; then steer so as to pass East of the Sherrard Isles, keeping between them and the reefs *u* and *w*. On the reef *u* there is a little islet covered with bushes. Cape Direction will then be passed, the little sandy islet covered with bushes and its reef being left to the East.

In passing Cape Direction, the bank off it and the detached Landsdown Reef, which is nearly two miles N.E. of the cape, must be avoided, and having passed these steer N. 20° W., leaving the reefs *y*, *z*, *a*, *b*, *c*, and *d* on the starboard hand, or to East, and the rocky island E.S.E. of Restoration Island to port or West; keeping this course for five miles beyond Cape Weymouth or Restoration Island, the long reef *e*, will be seen; then steer N. 40° W. along this reef until abreast of Cape Fair, where this reef terminates in a sharp point. From thence steer N. 35° W. to pass between East Piper Island and the reefs *h*, *i*, and *k;* then pass East or West of the reefs *l* and *m*, then West of Haggerstone Island, which is high and round on the East, the easternmost island of Sir Everard Home's group.

The anchorages between Cape Flinders and Cape Grenville are too numerous to mention. The N.E. end of every reef affords a good sheltered anchorage, but vessels should be cautious of anchoring near their shores on account of the current which is much stronger there than half a mile from them, and the depth is generally greater. If the day is advanced and the breeze fresh Night Island should not be passed, for the anchorages between it and Piper Islands are much exposed to the sea. A vessel leaving Night Island in the morning will easily reach the Piper Islands or Margaret Bay by night. The anchorage off Night Island is gained by rounding the northern point and anchoring with it due East, distant one mile.

Margaret Bay is West of Cape Grenville. The anchorage East of it is off Sunday Island, in 6 fathoms and well sheltered, with the island S.E.; it is a good place for rendezvous. In rounding Sir Everard Home Islands, pass outside of them, to avoid the current which sets N.W. towards them, across the vessel's course. Having passed these islands the course is N. 52° W, or N. 54° W. for Bird Islands, and from these to *v* reef, about N. 22° W. (N.N.W.) The best and most direct track to adopt is to pass West of the reefs *v* and *w* (although there is a good passage between them), and when abreast of the West point of the latter the course for Cairncross Island is N. 15° W. for about eighteen miles. In this track the Hannibal Islands will be left to port and the Boydong reefs to starboard.

As there is no good anchorage between Cairncross Island and Cape York it will be better to bring up under this island for the night in 13 or 14 fathoms mud; the island bearing S.E. it must not be approached nearer than half a mile, for there the bottom is rocky.

Leaving Cairncross Island, steer N. 56° W. (N.W.b.W.) until abreast of Escape River *x* reef will be seen. Pass East of it on nearly a N. 26° W. course, and leaving Turtle Island to the West, this course will lead East of *z* reef and afterwards the Albany Islands, which should be passed to port.

The passage through the Possession Islands and Endeavour Strait is not adapted for large ships there being too little water about the Wallis Islands near Shoal Cape. The route by the Prince of Wales Channel round the northern end of Wednesday Island and then Hammond Island is preferable.

Prince of Wales Channel.—The reef *a* being passed, Wednesday Island will be seen. In making for this island take care not to approach the rocky islands at the entrance of the strait between Wednesday Island and Horned Hill, the N.E. point of Prince of Wales Island, on account of several hidden rocks a quarter of a mile from the shore. then round the northern point of Wednesday Island at half a mile and steer W. 9° or 10° S. to pass North of the rock off Hammond Island. From this steer S. 53° W. and when abreast of the S.W. point of Hammond Island a reef will be approached to the South of the track, and on which several rocks dry. Pass half a mile North of it. In this course the reef *d* will be avoided, which is generally, if not always, covered, and the depth throughout will be from 6 to 7 fathoms.

When the summit of Goode Island bears S. 30° E., steer W. 7° S. towards Booby Island. This course will clear Larpent Bank, and having passed it the ship will be clear of Torres Strait. Having passed Booby Island, by steering W. ½ S. or W. 9° S. will gradually increase the depth of the water. North of these two routes, and West of Booby Island are several coral banks the positions of which are not well determined.

Satisfied of the superiority of the inner route over those through the Barrier Reefs, which have been generally taken for many years, Captain King says, I wish vessels would but try it, for the trial would end in its adoption.

The season in which Torres Strait is available is from April to October (the S.E. monsoon). The N.W. monsoon is accompanied by uncertain and cloudy weather, with rain and sometimes strong winds, against which it is impossible to make way without a great loss of time.

The passage along the N.E. coast of Australia is not subject to monsoons; the S.E. wind, with a little variation, blows on this coast nearly all the year. In the months of June, July, and August, it is sometimes, although not often, replaced by N.E. winds with cloudy and rainy weather; South of Cape Grafton (lat. 16° 51′ S.) these changes are less frequent. However the prevailing wind North of Break-Sea-Spit is S.E., and there are no difficulties for making a rapid passage.

Outer Route.—Captain Blackwood, in recommending the outer route when a ship is making for the passages of Raine Island, says,—Ships taking the outer route, on leaving Sydney should make for the Cato Bank or Wreck Reef, and on no account pass West of the meridian of 153° E. South of 17° lat., so as to avoid the Alert Reef. The current is variable in these parts, but may generally be expected to set West about one mile per hour, or sometimes a little more.

Having passed Alert Reef a ship must not allow herself to be set over to the Barrier, but be careful of the Osprey Reef. But having rounded it, a course should be shaped so as to make the Great Barrier Reef in 11° 50′ S. and 144° 10′ E., to avoid being set North of Raine Island Entrance.

Raine Island.—Raine Island is situated nearly in the middle of a large opening in the Barrier, with a safe channel on either side of it. It is composed of coral and is deficient of fresh water. It is covered with a thick grass, and a reef extends from it about a mile E.S.E. A stone beacon in the form of a lighthouse stands on its East point, about sixty feet high, painted in vertical stripes of black and red. In clear weather it is visible eight or nine miles from a ship's deck. It is in 11° 35′ 49″ S. and 144° 6′ E. High water at full and change is at 8h.; the rise and fall seven feet, or nine at the high tides. The flood sets W.N.W. and the ebb East about 2½ miles per hour, full and change. In the interior of the Raine beacon is a small stock of provisions and water.

The outer points of the reef forming the entrance of the Raine Island Channel are S. 26° E. and N. 37° W. of the beacon. No bottom is found with 125 fathoms in any part of this opening, nor in the immediate neighbourhood of the island.

The reef, which continues to E.S.E. from Raine Island, (and on which the sea breaks heavily,) and curving towards the West, affords shelter to a small space, where boats may land and, when the weather is moderate, small vessels may anchor in four fathoms at a stone's throw from the shore.

South Channel.—A vessel entering by the South Channel of Raine Island may run to the westward, keeping half a mile from the reef which extends from it, and continue on until the beacon bears North, distant 1¼ mile; then steer W. 26° S. nine miles, taking care to allow for tide and current setting to the northward, when soundings will be found.

North Channel.—To enter by the North Channel, when half or two-thirds of a mile from the North shore of Raine Island steer S. 44° W. for five or six miles, or until the beacon bears N. 52° E.; then a course W. 26° S. for about three miles will reach the same position in soundings as if entering by the South Channel.

Having gained soundings from 26 to 30 fathoms, a look-out must be kept from the mast-head for several low coral reefs near the edge of soundings. They will be easily discovered by their white appearance contrasting with the strong colour of the surrounding water.

In entering the Barrier no alarm should be occasioned by the sea breaking when in soundings, arising from the East wind blowing against the ebb. The ebb stream is always weaker than that of the flood, which latter joins the general current setting North along the edge of the Great Barrier. This northerly current is the effect of the Trade wind, and must be carefully considered not only in making the Raine Island Channels, but when they are cleared, so as not to be set northward to the parts which have not yet been examined. Should a vessel take either of these channels on the flood at springs, there will be much risk of her being set to the northward by the current, and, should it be evening and getting late, anchorage should be got as soon as soundings are found. But if there is still plenty of daylight, a course may be steered for the Middle Banks, which are covered at half tide.

A course W. 26° S. 16 miles would reach the Middle Banks if assisted by a good ebb tide, but under all circumstances it will be proper to compensate for the effect of the northerly current by steering a point or a point and a half more southerly.

A ship having entered Raine Island Channel when the day is advanced should steer for the Middle Banks, which will be seen to starboard after having run twelve or thirteen miles from the edge of soundings; and at the same time Sir Charles Hardy Islands will be seen ahead. Anchorage may then be taken for the night abreast of the Middle Bank, in 12 to 16 fathoms. At daylight all the dangers of the route will be clearly seen from the mast-head, and care should be taken at all times to have the ship under handy canvas, with an anchor ready for letting go.

From the anchorage of the Middle Banks there are three channels for reaching Cape York: these are the North Channel, Pollard Channel, and Middle Channel.

North Channel.—If Raine Island be passed early in the morning and Middle Banks are reached towards noon, the North Channel is the shortest route for the Bird Islands, and by keeping West of these islands a good anchorage may be had in 10 fathoms, mud. In this route steer W. 1° S. nine miles, allowing for the tide, so as to pass between the spit extending N.E. of Cockburn Reef and several detached banks North of it. The reef always breaks, and may be rounded even within half a mile. When abreast of its eastern extreme we may run W. 1° S. for five or six miles for the Cockburn Islands, as well as the edge of the Cockburn Reef, which, when it does not break, shows by the change in the colour of the water. This may be passed at a distance of half a mile until abreast of its N.W. extreme. Here the course should be altered to W. 18° S. for three miles, to avoid the rock, marked awash, W. 10° N. at 2⅔ miles of the North extremity of Cockburn Reef. When this is passed the course should be shaped to go South of Bird Islands, passing South of Low Island, or run W.N.W. North of these islands for the Inner Route of Captain King, already described, and which leads to Cape York.

Pollard Channel.—A ship abreast of the Middle Banks may take the Pollard Channel for the Bird Islands, as it is perfectly safe, although narrow. In doing so, the East point of Cockburn Reef must first be recognized. A ship should then run along the edge of this reef at the distance of half a mile, that being always visible. The channel is formed by this bank on the North, and on the South by another long bank continuing nearly parallel to Cockburn Reef, which is equally perceptible by the change in the colour of the water; and in skirting the edge of Cockburn Reef care must be taken to avoid a small isolated coral rock which is near its southern point.

Tide rips will be generally met with in this channel, but the least depth in it is 25 fathoms. When the Hardy Islands are well open of each other and the northernmost bears E.b.N. and the southern one East, and when the largest of the Cockburn Islands is N.N.W., all the dangers of the Pollard Channel will be cleared, and a course may be steered so as to pass on either side of the Bird Islands. When these islands are gained all possible sail should be made for the Inner Route of Captain King to Cape York. It may be as well to observe that near the shore the bottom is mud, and that there are no hidden dangers. Bird Islands should be reached as soon as possible, for a ship once arrived at these islands may be considered to have passed all the dangers of Torres Strait.

In case of having passed far South of the Middle Banks in taking Raine Island Channel, a vessel might find herself near the Ashmore Banks. These banks (three in number) are not covered, but always visible at the distance of three or four miles. It may be advantageous, perhaps, in this case to take the channel leading to the Hardy Islands, and should water be required it may be had at South Island, where there is an abundance of it, especially from March to July. The spring will be found on the South coast, opposite a small rocky islet, which is about half a mile from the shore.

The Hardy Islands may be distinguished at a great distance, and are excellent points with which to determine the ship's position. They are separated by a narrow but safe channel, in which there is a depth of 6 to 8 fathoms. These islands are inhabited, and anchorage may be taken up in the same depth on a bottom of coarse sand.

It is high water at full and change at 9h., and the rise and fall about 10 feet. The flood, as before observed, sets N.W., and with strong S.E. winds runs about 2½ miles an hour.

Ships from the anchorage at the Hardy Islands have reached the Bird Islands without accident, but the routes they have taken have not yet been sufficiently examined, and Captain Blackwood considers it best to steer N.E.b.N. in leaving these islands for the Pollard Channel.

Middle Track.—With a certainty of fine clear weather, a vessel not drawing more than 13 or 14 feet of water may safely adopt the Middle Track. In which case pass South or North of the Middle Banks, steering N. 18° W. thirty miles, keeping a good look-out for several low coral reefs near this route, and which will be distinctly seen if the sun is not ahead. Having run this distance, then steer N.W. twenty-five miles, and a sandbank will be observed to port and the wooded Arnold Island. Several sandbanks and reefs will be passed in this track on either hand. Ten miles E.b.N. of Arnold Island there are three sandbanks, surrounded by reefs. In this part the bottom is mud, and there is nothing to fear from hidden dangers. Pass between Arnold Island and the three banks abovementioned, and then steer towards Mount Adolphus, the summit of which is flat and can be seen at the distance of eleven leagues. Then make for Cape York, passing through a safe channel, four miles wide, between the *z* and *y* reefs of Captain King, the Brothers Islands, and several reefs to the eastward of them.

Pandora Entrance.—North of the entrance of Raine Island, in 11° 26′ 40″ S., there is another opening in the reef, called the Pandora Entrance. A vessel intending to take this route across the Barrier Reef, as soon as in soundings should run between the banks, the shores of which are visible towards a sand covered with bushes, situated in 11° 19′ 30″ S. From this bank, South of which several others are visible, she must run forty-eight miles to N.W., keeping between the banks, and thus gain the Middle Route, and stand on for Arnold Island.

So far, says Captain Blackwood in his two publications; and, in order to make the directions for Torres Strait as complete as possible, we shall add the contributions of the *Astrolabe* and *Zélée*, under Admiral Dumont d'Urville.

Route of the Astrolabe and Zélée.—The route that these ships took led them to the entrance of Bligh Channel. They passed North of Anchor Cay; then between the reef extending N.E. of Darnley Island and the detached reefs abovementioned. From thence North of of Nepean Island and near Stephens Island; then North of Dalrymple Island: that is to say, as far as this island the route takes Bligh Channel in its northern part.

From Dalrymple Island pass West of Rennel Island; then, skirting the southern edge of the Great Warrior Reef, cross this reef East of Warrior Island by Mauvais Channel, which is extremely narrow. The large channel here, between Warrior and Dungeness Islands, in all cases is much better than Mauvais Channel, which well deserves its name. At the outlet of this channel the route lies directly North of Brothers Hills, and South of the small Nicholls Cays, which are about 4⅓ miles North of those hills. From this island—composed of two high hills—it becomes nearly W.S.W. ½ S. for the North coast of Mulgrave Island, leaving Orman Reef to the northward, which this navigator intended to cross in 1816, but could not. Passage Island, Jervis, and several smaller islands fringed with reefs, mark the northern edge of this channel, the westernmost of which is Farewell Island; and leaving to the South the Watson Cays, Possession Island, Black Rock, and the reefs which show along the North side of Mulgrave Island. As soon as this and Farewell Island are passed the ship is free of the strait, and enters the Indian Ocean.

We will now state Captain Bannatyne's opinion on the Outer Route, which he made from Sydney to India, passing Torres Strait by Bligh Channel. He left Sydney on the 1st July. On the 6th passed between Wreck and Kenn Reefs. On the 12th, towards midnight, he was between the Eastern Fields and New Guinea. At 10h. the following morning he saw the breakers of Portlock Reef; at 4h. in the afternoon he rounded their N.E. point, and about 10h. was steering for the entrance of Bligh Channel. The lead at 4h. in the morning gave 50 fathoms, sand and coral; at 8h., 40 fathoms, black sand. At 8h. 30m. he saw Bramble Cay, distant seven or eight miles N.W. At noon Stephens Island was three miles South, and at 4h. in the afternoon he anchored in 15 fathoms, on mud and sand, a cable's length from Rennel Island. The next morning at 7h. he was under sail; at 8h., abreast of Arden Island; at 10h. he rounded the North sides of Village and Cocoanut Islands, and then the South side of the Sisters Bet, Sue, and Poll. At 4h. in the morning he passed between Double and Wednesday Islands, and at 6h. 30m. the West Point of Goode Island was one mile South. Thus by this route the strait was passed in thirty-four hours, fifteen of which were at anchor under Rennel Island; and it occupied only thirteen days from Sydney.

This channel, says Captain Bannatyne, one of the best that I have seen, appears to me to be destined to become the high road for ships running both ways between India and the eastern coast of Australia, and especially steamers. The New Guinea or Bligh Channel, according to Captain Bannatyne, is the best that can be taken, either from the Indian or the Pacific Ocean, and either with the N.W. or S.E. monsoon.

We have shown how opinions differ with regard to the routes that may be taken in these parts, and shall now leave captains to choose one from among them. Captain Robson, who has long studied this question, has thus summed up the advantages of both routes:—

The advantages of the Inner Route are:—First,—That this passage has been completely surveyed; that we have excellent charts of it, accompanied by directions (those of Admiral King) which include its whole extent. Second,—That the entrance of the channel presents no difficulty, and there are no dangers in the vicinity of Breaksea Spit. Third,—That in this part of the channel (under favourable circumstances) a considerable distance may be navigated even at night. Fourth,—That anchorage may always be had when necessary. The inconveniences which this same route presents are those of navigating the narrow passages from Cape York to Sandy Cape, while the other route is made in an open sea. In fact, for the first 500 miles from Cape York the greatest care is required in the navigation, and the ship must anchor every evening. This occasions much trouble and loss of time. The remaining 300 miles may be run during the night, but only when it is very clear and easy to make the land. Another disadvantage of this route is the additional distance to be run, amounting to about 700 miles.

The advantages of the Outer Route are;—First,—That it is shorter than the Inner. Second,—That as far as 12° S. the ship is in an open sea. Third,—That the openings in the Barrier are now well known. Fourth,—That the distance from the Barrier to the Bird Islands, where the routes unite, is little, so that a vessel entering by either of these openings is not generally obliged to anchor more than two or three times, or four at most.

All this, says Robson, may be considered as true. It now remains to look to the Great Barrier itself. Commencing South and going North, we find the first and second passages, where in 1780 Bligh's launch entered, Captain Cook in 1770, and the *Hibernia* in 1810. Further North are the Nimrod, Brown, Winter, Stead, and Grove Passages, and others without name, which are also considered safe. These passages are well known. Then North of Raine Island there are the Yule, Fly, Cumberland, and Flinders Passages, the two latter near the Murray Islands.

Although, says Robson, everything appears to be in favour of the Outer Route, I consider the Inner one as the best on account of the single fact, which is of the greatest importance, that the weather during the S.E. monsoon is very changeable, and a clear sky is full often suddenly clouded by the breeze freshening and bringing rain and fog! A ship approaching the Barrier under these circumstances is exposed to considerable danger. She has no anchorage or shelter to run to, and must take her chance under the influence of a strong lee current and a strong wind blowing directly on the reef.

Robson then gives several instances in support of this opinion that need not be repeated here. He then compares the length of the passage by the Outer Route with that by the Inner one, the length and trouble of which latter he says are exaggerated. Thus, by the Outer Route the *Flora* made the passage from Sydney to Torres Strait in 22 days; the *Bentinck* in 28 days; the brig *Winter* in 22 days. By the Inner Route, a convoy of eight vessels, led by the steamship *Crocodile*, from Sydney, reached Booby Island in 23 days; the brig *Helen* and *George Hibbert*, both leaving Sydney and being obliged to anchor several times, reached Booby Island in 29 days, 11 days of which were passed at the anchorage on account of bad weather, quite unusual. And then he concludes with directions for Stead Passage.

Stead Passage.—In some directions, he says, for Stead Passage it is recommended to make Yule Reef in lat. 12° 2′ S., and to pass round North of it for the Barrier. Notwithstanding my respect for the able seaman who has given these directions, I do not agree with him here, on account of the prevailing E.S.E. and S.S.E. winds. Stead Passage is situated at the end of a deep bay in the edge of the Barrier curving in to the West between lat. 11° 57′ and 12° 7′, and with S.E. winds a vessel passing North round Yule Reef, and from thence running for Stead Passage, would be in the bay to leeward, and would not find an entrance through the Barrier to leeward of this nearer than Grove Passage, if circumstances obliged her to enter it North of Stead Passage. Besides, Stead Passage is tortuous, and if the wind hauls southerly it would be difficult to cross the Bank. Moreover, there is a rock in the middle of it, and although it is considered to have sufficient water on it, such things are dangerous to pass when we have any doubt concerning them.

On the contrary, a ship should pass South of Yule Reef; then she would approach the Barrier from to windward, and the more to windward or southward the smoother the sea, because it is sheltered by that part of the Barrier Reef which projects to the S.E. By keeping to windward a ship would have the advantage of choosing which of the two channels would be most convenient. Thus, in approaching the Barrier the Nimrod Passage will be seen, and supposing that she does not desire to take it, she may run along the reef and will see successively those of Stead, Grove, and Raine Island to leeward, and may adopt either of them. But this opinion, adds Robson, is not only mine; Captain T. Johnson, of the *Recovery*, thinks so likewise.

The opinion of Captain Mackenzie on the Outer Route is also entitled to respect, he having much frequented these latitudes. The *Gambia* made the passage from Sydney to Booby Island in twelve days by Bligh Passage. Some observations which he made on it are also important.

The Prince of Wales Channel to Endeavour Strait, he says, seems to be preferable under all circumstances, for it is studded with islands, which are good marks. It is also safe, has no sunken rocks, has moderate depth, allowing of anchoring at any time and anywhere. But in Endeavour Strait the four known rocks there, as well as those discovered between Entrance and Little Woody Islands by H.M.S. *Rattlesnake*, make the navigation less safe, and do not allow of stopping through the night.

The route here followed, again says Captain Mackenzie, has all the advantages of the Inner and Outer Routes. The coast of New Guinea, as well as the Portlock and other reefs, do not admit the heavy sea that is found outside the Barrier. Besides which, here we have the lead to guide us. The sun is never ahead in Bligh Channel to dazzle with its light, allowing the reefs to be easily seen. It is not necessary to keep further to windward than S.S.W., and should the wind fail there is plenty of room for working in. If a fog or bad weather obliged a ship to stop, anchorage may be had anywhere with convenient depth; and having gained N.N.E. of Darnley Island, all danger is over with a fine night, although without the moon a vessel should keep under handy sail as far as Wednesday Island, with a moon she would press all sail to get through. In conclusion, says Captain Mackenzie, this is the route which all merchant ships should adopt. He also blames those captains who from prejudice still adopt Stead Passage or any other in preference to that of Raine Island, especially since the beacon has been established on this island.

In the West monsoon, he says, when coming from the Indian Ocean, the best route to take for Raine Island is the Inner one of Captain King.

In favour of the Inner Route the opinion of King is very important;—that of Robson, and even Blackwood, also, who consider it as being the safest. For the Outer Route we have broad facts, in spite of the objections of Robson. This route is evidently the shortest, as Captain Blackwood admits. It is right that seamen should have these different opinions on the advantages and disadvantages of the two routes. Without deciding the question, they are good illustrations of it, and assist them in deciding on either when necessary. Perhaps when a ship is not pressed for time the Inner Route might be adopted; and the Outer Route when the saving of time is important. Hence the latter may become the route most generally adopted by merchant vessels, as a quick passage is the first consideration. In this case we should be for reaching Torres Strait by Bligh Channel and then the Prince of Wales Channel, and reverse it, according as we were going East or West.

Route from Sydney to India by Pitt Passage.—The best route for India or China from Sydney, when either of those by Bass Strait or Torres Strait are not adopted, appears to be to pass to the East of New Guinea, taking Pitt Passage for running through the Java Sea from East to West, or leaving it by Ombay Strait. In which latter case, on leaving the Java Sea the course would be South of the Sunda Islands. This route, as well as that to the North, should, however, only be taken from March to September,—that is when the S.E. monsoon prevails South of the equator.

In leaving Sydney the course would be to the northward of East as far as the meridian of 160° E.; then North, keeping near this meridian, and passing East of Howe and Middleton Islands, Wreck Reef, and Cato Bank. Captain Bristow, however, considers it preferable from Sydney to keep along the coast as far as Sandy Cape, and to pass West of these reefs.

New Caledonia should then be left to the East, the dangers of these latitudes being provided against, and the course should be shaped for Cape St. George, the South point of New Ireland. In making for the St. George Channel and Pitt Passage always keep at a moderate distance from the coast of New Guinea, guarding against the easterly currents and light N.W. winds which are sometimes found to drift vessels seaward. From March to September a ship having reached the meridian of 134°, should keep near the coast of New Guinea when approaching Pitt Passage with the S.E. monsoon. Instead of taking St. George Channel, enter that between New Brittany and Cape King William, passing East or West of Rook Island; from thence steer so as to pass between Lottie and Long Islands, or round the latter to the West, according to circumstances. Then keep along the coast of New Guinea, passing North of the islands off it, from Astrolabe Gulf to Dumont d'Urville Island, and follow the coast as far as the point of that name. From thence steer so as to pass North of the Traitor, Mysory, and Providence Islands. Then keep the coast of New Guinea in sight as far as Cape Mamori, and, continuing along it to the Cape of Good Hope, make for Pitt Passage by Dampier Strait. This route of the *Astrolabe* is shorter and more direct than that by St. George Channel, and is less dangerous.

Pitt Passage being gained by Dampier Strait, or by that which may be most convenient, the directions already given in the Indian Ocean may be adopted for proceeding to China, passing East of the Phillippines.

When the N.W. monsoon prevails South of the equator a ship from Sydney to India should not, as in the foregoing route, proceed by the coast of New Guinea. In November, December, and January it is better to keep as far as the parallel of 5° N., near which N.E. winds will then be found. At this season pass South of Mindanao by Basseelan Strait, cross the Sooloo Sea, and then enter the China Sea by Balabac Strait, rounding the northern part of Banguey and Balambangan Islands. From there, crossing the China Sea, make for Malacca Strait. This route is, without doubt, the best for India in the N.E. monsoon from the East coast of Australia or Tasmania.

Eastern Routes to China from East Coast of Australia.—A vessel from the East coast of Australia bound to China or India, during the prevalence of the N.W. monsoon South of the line (from September to March), and not desiring to take the southern route, strong winds will have to be encountered in taking the eastern route, that is to say a more easterly route than the last mentioned.

In this case two routes are generally taken, one passing West of New Caledonia, the New Hebrides, the Islands of Santa Cruz, and East of the Solomon Islands; the other is East of New Caledonia, the New Hebrides, and Santa Cruz Islands. These two routes are nearly the same as that already mentioned as the Great Eastern Route from the Cape of Good Hope to China.

In taking the first of these routes, a ship from Sydney should steer E.N.E., in order to profit by the regular breezes that prevail at sea, and having reached the meridian of 160° E., should pass East of Howe and Middleton Islands in running to the northward, as S.W. winds are often met near New Caledonia; but care should be taken not to approach it too close. After passing East of New Caledonia, steer North, keeping on the meridian of 164°, for the channel between the Santa Cruz Islands and the Solomon Archipelago.

Having passed this archipelago (if in the first months of the monsoon) a course may be shaped for China. Crossing the Caroline Archipelago, steering North, and having cleared them, run for the Isle of Guam, where one of the channels between the Marian Islands may be taken. Then steer for Formosa Strait, and then run between the Bashee Islands.

In case of not reaching the Solomon Islands till after January, when the N.E. monsoon begins to fail in the China Sea, a route between Guap and Goulon Islands, or between the latter and the Pelew Islands, may be taken. From thence steer so as to round the N.E. point of Lucon, and then take the most convenient channel for Formosa Strait and China.

Second Eastern Route.—The second eastern route from Sydney for China is longer than the foregoing, but has fewer dangers, besides the advantage of more regular winds than those West of New Caledonia and the New Hebrides; for when passing to windward of all these islands a ship would have to guard against the westerly current found in crossing the S.E. Trade.

From Sydney make for a sight of Norfolk Island or pass a little East of it. Then make for Isle Mathew (the volcano), which will be seen seven or eight leagues; then pass East of New Caledonia, the New Hebrides, and the islands near them; leave the Feejee Islands to the eastward, taking the course most convenient for the New Hebrides, and keeping the meridians of 171° or 172° E. If Erronan Island, the easternmost, cannot be weathered, take the channel between it and Tanna; then run North as far as the parallel of 13° S. If the New Hebrides are not sighted either Tikopia Island or that of Fataka must be. Then continue North, so as to cross the equator between 160° and 168° E. As the Western current is generally strong, a ship should try to reach the Carolines by keeping on the meridian of 163° E., and having crossed the equator in 160° or 162° E. a ship should determine to cross this archipelago between 156° and 155° E.

When leaving the Carolines pass South of the Mariannes or through one of the channels formed by these islands; from whence make for Formosa Strait and the China Sea.

In the above routes, if delay on the passage prevents arriving in the China Sea till after the N.E. monsoon is over, in such case when North of the equator change the latter part of the route by passing South of Mindanao for Basseelan Strait, then cross the Philippines, taking Panaou or Surigao Strait, or that of San Bernardino. The first is North of Mindanao, the second North of Samar. By the first the Sooloo or Mindoro Sea is taken; by the second the China Sea is taken North of Mindoro. The route South of the latter island may also be taken for Mindoro Strait, but from the Pacific the route for the China Sea by the San Bernardino Strait is generally preferred to that of Surigao.

We have here treated generally on the navigation of the Pacific Ocean and that of its western borders. We may now refer to the navigation of the eastern coasts of this extensive ocean, but first to the subject of passing from the Atlantic into it round Cape Horn.

Doubling Cape Horn from the Atlantic.—Seamen who have doubled Cape Horn have given different directions on some points of the subject, but those will be adopted here which appear to be the most trustworthy. But before pointing out the proper routes it may be right to say a word or two on the most favourable season for entering the Pacific from the Eastward.

Captain J. Weddel grounds his opinion on the experience of five years in navigating these parts, and considers the months of March and April as the worst for doubling Cape Horn. He says the difficulties of doubling this cape may be greatly diminished by choosing the proper season for it, and loss of time may be avoided as well as injury to the ship.

In the beginning of November northerly winds set in and continue till the middle of February, when they are succeeded by those from S.W. During these months the westerly wind is not of long duration, and then the passage is easily made. From the 20th of February, or thereabouts, to the middle of May the winds generally vary between S.W. and N.W., and are very strong. During this time, therefore, a badly-found ship and one that is not tight should not attempt the passage. But from the middle of May to the end of June the prevailing winds are easterly, with fine weather; and these six weeks offer a good opportunity for doubling the cape, even in sight of the island of Diego Ramirez. Then in July, August, September, and October the prevailing winds vary from S.W. to N.W., and August and September are especially stormy months.

These remarks appear conclusive as to the best time for doubling Cape Horn.

As to the route to be adopted when from the eastward, continues Capt. Weddle, this greatly depends on the time of being off the cape, and on the strength of the westerly winds which prevail in these latitudes. I prefer, under all circumstances, to pass West of the Falkland Islands.

In the summer the strait of Lemaire may be taken, as it shortens the passage by fifty or sixty miles; and this may be done without danger provided we have daylight for clearing it, admitting that at the southern end we meet with southerly winds.

Cape Horn is about thirty-one leagues from Cape Good Success, with Barnevelt Island between them. If desirous of anchoring near Cape Horn the route S.b.W.¼W. (compass) during the night will take a ship clear of the N.W. current which sometimes sets among the islands at the entrance of Nassau Strait. If not intending to anchor. the most advantageous route after leaving the strait of Lemaire would be to make to the southward, passing South of the cape and Diego Ramirez at a distance of several miles.

In the summer, when working westward in the vicinity of the cape, towards evening take care to be near the coast of Terra del Fuego, because during the night northerly winds often come off the land and veer West in the morning. This, however, depends in a great measure on the seasons mentioned for passing Cape Horn. In fact, during those months when the wind is most violent, as in March, August, and September, the seaman should follow the directions given by Anson and King, who recommend standing to the South as far as 60°, where a smoother sea and more moderate and steadier winds will be found. Nevertheless, when a ship is obliged to make her passage along the coast, the places where she may anchor with safety are Wigwam Bay, Port Maxwell, Indian Cove, New Year Sound, and Clear Bottom Bay.

Such are generally the remarks of Captain Weddel. We will now see what others say on doubling the cape.

As we have already observed, Captain King recommends a ship from the Atlantic intending to double Cape Horn to run down the coast of Patagonia at a hundred miles distance. Captain Fitz-Roy does not agree in this opinion. I do not think, he says, that it would be important for a large well built vessel to keep near the East coast of Patagonia. The sea, it is true, is smoother there, but the current near the coast sets northward with more strength than out at sea. But, when in sight of the coast, no ice is met, while further East it is found even North of the parallel of 40° S. Instead of going to the South as far as the parallel of 60° S., as Captain King says, I prefer to work to the westward near Terra del Fuego, towards Nassau Bay. In Orange Bay a ship may await a favourable moment to make a long board to the West. If disappointed of this, she may return to her anchorage under Black Island in Euston Bay, or elsewhere, and await a more favourable time. To make Westing is the principal object to be kept in view till we reach the meridian of 82° West. We do not find ice near Terra del Fuego, but frequently meet with it seaward from this island. In the route here pointed out near Cape Horn and the land many dangers and injuries to the vessel will be avoided by remaining quietly at anchor during the bad weather and profiting by any change of weather or wind to make westing. It appears from this that Fitz-Roy prefers in all cases the route nearest the land.

Weddel's opinion differs from his, for he advises this route during summer, and the sea route down to the parallel of 60° or thereabouts during winter.

Fitz-Roy's opinion is here supported by that of Cook, La Perouse, and Krusenstern, as well as Capt. Beechey. I do not see, says this officer, the necessity for going far South to double Cape Horn. One thing I only recommend, namely, to adopt that tack on which most westing is made without thinking of latitude further than to pass twenty leagues South of this cape. With N.W. winds I should run S.W., and with S.W. winds N.W., and in case neither board is favourable, I would stand to the southward, unless I was in too high a latitude. The strongest winds are not found near the coast, as is supposed; quite the contrary: and at thirty miles from it, the sea breaks from the inequality of the bottom. There is, however, one serious objection to approaching the coast East of Cape Horn, and that is, the rapidity with which the current sets across Lemaire Strait, particularly with southerly winds. This is not the case West of Diego Ramirez, and I do not see any objection in this part to approach the coast to about forty or sixty miles. Near Diego Ramirez I found little or no current.

When doubling Cape Horn from the eastward, we should pass inside or West of the Falkland Islands, and pass East of Staten Island, but as near as possible to it, because S.W. winds are often met with as soon as the Pacific Ocean is open. N.W. winds off the Falklands generally become West or S.W. as Staten Island is approached, and with the wind from West off this island we have only to run South. However, this course need not be taken unless we can make westing. Even if we gain little or nothing on the other tack, we should keep near the shore, for there is no advantage in making southing if it is not to avoid losing in the westing. We should not, however, take much liberty with the coast while East of Cape Horn. Such are the most general rules for doubling this cape.

As to passing through Lemaire Strait, or outside Staten Island, opinions differ. The prudent course is to adopt the latter, although the passage through the straits gains to windward and shortens the route. But with a southerly wind it should never be taken, for with the tide running against the wind, the sea in the strait becomes boisterous. With a calm it would still be wrong to adopt it, unless the West coast of the strait (for anchorage) cannot be reached, on account of the tide setting towards Staten Island. Everywhere else the anchorage is in deep water and close to the shore. However, with northerly winds, this route appears to be very advantageous. Such is King's opinion, and Captain Fitz-Roy's also, whose opinion is unquestioned, and who considers that there is no difficulty in taking Lemaire Strait. The only danger to be apprehended is calm. Vessels from the southward are not very liable to this danger, in S.W. winds at least; and in this case they would probably find N.W. winds in the northern part of the strait. The bay of Good Success is, however, admirably situated for affording shelter should wind or tide fail.

In passing Staten Island from the southward, the tide rips, extending some distance off the N.E. part of the island, should be avoided; but there are no dangers near the island. The foregoing is sufficient to convey an idea as to how to double Cape Horn from the eastward.

Most seamen who have frequented these latitudes (as King, Basil Hall, Beechey, La Perouse, &c.) agree that the barometer does not give any certain indications near Cape Horn, and that it can only be depended on in middle latitudes. That although the mercury often rises or falls before a change in the weather, the rising or falling more often follows the change. The mean height of the barometer is 29·5 inches. With N.W. winds the mercury is low; if it falls to 29·0 or 28·8 inches, expect S.W. winds, which only commence when the mercury ceases to fall. But again, a fall in the mercury often occurs without being followed by any change in the weather.

Magellan Strait.—In reference to the straits of Magellan, King's directions for the Patagonian coast must be followed by vessels from the Atlantic to the Pacific. For steamers, especially if small, this passage will be advantageous; but with a sailing vessel it is both tedious and dangerous.

For a small vessel coming from the Pacific to the Atlantic, the passage of Magellan Strait is very advantageous. It is always safe, very nearly as quick, and not so dangerous as the route by Cape Horn. Thus: Entering by the gulf of Trinidad, she would take Conception Strait, Sacramento or St. Esteban, then Smyth Channel, and the strait at Cape Tamar. In these channels northerly winds prevail, and anchorages are at hand to pass the night in.

The winter months are undoubtedly the best for the straits of Magellan when going West. When coming from West the summer months are preferable; the nights being short and westerly winds prevailing.

Doubling Cape Horn from West.—Passing from the Pacific into the Atlantic Ocean by Cape Horn, the principal objections are: dark cloudy weather, a heavy sea, and floating ice. For a large ship the passage is easy enough, and the summer months (January and February) are considered as the most favourable for it. A small vessel having doubled the cape, would do better, and find a smoother sea, by passing inside the Falkland Islands from Lemaire Strait. For a large vessel Beechey considers it preferable to pass East of the Falkland Islands, especially in the winter, because the wind has then a hankering for the eastward, and thus, when past the islands, she would be in a good position for reaching the River Plata.

One of the most formidable dangers of doubling Cape Horn is that of smashing a low iceberg at night, when it is blowing fresh and a heavy sea running. According to all seamen it appears that in the winter and spring months (July, August, and September) they are most commonly met with. Sometimes these floating masses are only a few yards above the water, and therefore very difficult to discover in the night. In the dark nights of winter these dangers therefore are to be provided against by the best look out that can be kept: for they are mostly met in fresh winds and a heavy sea. And, as Captain Basil Hall advises, it will be best at night under such circumstances to lie off the cape. With fine weather and a quiet night small sail may be carried, but the look out should be doubled, the greatest possible precautions adopted, the sails being set so as not to prevent the watch from seeing all round. The following precaution is recommended by him. Having reefed the topsails and courses, the yards should be braced nearly sharp up, bowlines hauled, and everything ready for going about in the night, however the wind might come. Then, when an iceberg is seen near ahead it may be avoided by putting the helm up or down. In all cases the yards braced in renders either plan easy of execution.

The foregoing are the best instructions seamen can have for doubling Cape Horn under all circumstances; and we will now consider the navigation of the western coast of America.

Navigation of the West Coast of America.—The navigation of the western coast of America presents no difficulties, care being taken, if going North, to keep in Humboldts Current, and in running along the North coast during summer advantage should be taken of the Mexican Current. Thus the passage may be easily made from the straits of Magellan to Acapulco, by taking care to profit by the monsoons of the Chili coast; and the passage will be shorter or longer according as the monsoon is favourable or not.

A ship bound to Acapulco, or the coast of Mexico, in the winter, when the current is running S.E., and the monsoon blowing N.W., should get away from it as soon as she has crossed the equator, and navigate so as to pass East of Clipperton Island, in order to keep out of their influence. She should then get to the northward of the parallel of Acapulco, and take care to make the land well North of it.

From Cape Horn to Mexico.—A ship from Cape Horn to any Mexican port, should profit by southerly winds, so as to cross the equator in about 100° W. long. picking up the N.E. Trade winds on a meridian 6° or 7° East of the port to which she is going, as San Blas or Mazatlan, and avoid the westerly currents and variable winds met with near the Galapagos. From these islands to Cape San Lucas, says Commander James Wood, it must be observed that the Trade winds do not blow with so much force and regularity East of a line from this cape to the Galapagos. Among these islands S.E. winds are prevalent during nine or ten months of the year. In January and February and sometimes in March, they are interrupted by long calms or northerly winds, which are never strong. North of these islands the eastern limit of the Trade appears to depend on the time of year. In the beginning of April, between the parallels of 8° and 13° North, this limit is 900 or 1,000 miles further East than in the month of June; and in the other months it is more or less East as the season is more or less advanced. In no case is the Trade found to be so fresh and regular as it is West of the line abovementioned. It is the prevalence of westerly winds, calms, and contrary currents in the space comprised between the coast and this line, which renders it so difficult for a ship to make westing from Panama. It has taken sometimes forty days to get from Panama as far as 112° W., the western limit of the Trade winds, a distance of about 2,000 miles. A ship having once got the Trade, can run West, South, or northward; but it must not be forgotten that the eastern limit of the Trade greatly depends on the season. Thus in June or July we find fresh breezes from N.N.W. and even sometimes from N.W. as far as the meridian of 127° West, while in March and April we meet with light winds from N.N.E. varying to East and E.S.E. on the meridian of 100° West. These winds have then gradually reached the meridian of 112°, (that of Cape San Lucas,) West of which the breese is fresh from N.N.E.

As a general rule, it is found that in proportion to the distance off shore, and without any consideration of latitude, the wind draws easterly.

Navigation of the Chili Coast.—There are two modes of navigating the coast of Chili. In going North, the course is steered direct for the port of destination as the prevailing wind permits. In coming South, we do the same if we can: if not, we lay the ship's head as near it as we can, taking care when braced up the sails are clean full, for the principal thing is to cross as soon as possible the zone of contrary winds and gain a latitude where the ship can make a direct course. It is always best in making a passage to keep clean full.

Navigation of the Peru Coast.—On the coast of Peru it is easy to run North.

Route from Valparaiso to Callao.—Thus, in going from Valparaiso to Callao, says Captain Basil Hall, we nearly always have the wind from the same point, S.S.E.; it sometimes varies a point or two easterly, and the passage is always safe and easy. The only precaution necessary is to keep off the shore in steering N.W., so as to be 150 miles from it, and then to run direct for San Lorenzo, a high island and easily recognized, forming the eastern entrance of Callao Bay. We generally make the land of the Morro Solar, which is nearly ten miles South of Callao, and then run through the Boquerou Passage, or else round the northern end of San Lorenzo for the bay. In the Boqueron Passage the lead should be kept going, and an anchor ready to let go. The passage from Valparaiso to Callao is about nine days.

In making to the southward along the coast of Peru, much practice and skill are required, and seamen differ in opinion as to whether the passage should be in shore along the coast or out at sea. Captain Basil Hall says on this subject:—

Route from Guayaquil or Payta to Callao.—In leaving Guayaquil or Payta for Callao, we should keep near the coast until as far as Lobos Islands, and always endeavour to be near the coast a little after sunset, as this is generally the time when the land breeze commences. Although it is light, it enables a vessel to get on during the night along the coast, and she will be in a good position in the morning for the commencement of the sea breeze. After rounding Lobos Islands, work along their meridian as far as the latitude of Callao, then stand in shore, and if that tack does not fetch the port, another board or two must be made. This passage with a fast vessel is generally made in twenty and often in eighteen days. We have attempted to make this passage by keeping out at sea for several days, in the hope of reaching the port on the other tack; but very little is thus gained, on account of the northerly current found on approaching the equator.

From Callao to Valparaiso.—From Callao to Valparaiso is a much longer passage than from Valparaiso to Callao, from having to cross the S.E. Trade, to the southward of which are the westerly winds. But for the intermediate ports, except Coquimbo, as they are within the limits of the Trade, it is only with these winds that we can reach them. For any of these ports a vessel should make along the coast as above said as far as the Island of San Gallan, when the shore turns more easterly, allowing the ship to make a long leg and a short one, taking care always to keep the land in sight until she reaches Arica or any port between it and Pisco. On leaving Pisco the shore lies nearly North and South, and in going South it is not necessary to keep more than fifteen or twenty leagues at furthest from it, so as to be sure of having the sea breeze. A ship might keep on thus as far as the latitude of the port of destination. On no account should a vessel stand far out to sea, for in approaching the Trades the wind gradually becomes East, and it is often very difficult even to regain the port that we have left.

With a very bad sailing vessel it will be better to run free across the Trade winds to find the variables, and then run North along the coast, than to work unsuccessfully against them, since they only vary a few points.

The passage of a moderate sailing ship from Guayaquil to Callao is from fifteen to twenty days, and from Callao to Valparaiso about three weeks; but under peculiar circumstances, such as a northerly wind, this passage is made in much less time.

From Valparaiso to Conception.—The prevailing wind along this part of the Chilian coast being southerly, a ship from Valparaiso to Conception, in order to profit by any changes in it which will allow her to make southing, should keep along the coast, for it is seldom that it remains steady for twelve hours together. The passage from Valparaiso to Conception is generally made in ten days.

Navigation from the Southward to Panama.—A ship from the southward for Panama may make her passage without any difficulty, according to Captain Wood, during the greatest part of the year; but in the fine season, when northerly winds prevail, she may adopt the following course. She should make short boards near the coast, where she will find a northerly current reaching a few miles off shore. When this current is interrupted, the tides are not so regular, while out at sea the current is constantly contrary. Between Point Chirambira and Cape Corrientes the coast is fringed with banks thrown out by the rivers; but southward of Cape Corrientes, except off Point Francisco Solano, where there are off lying rocks, the coast may be safely approached. Still, a vessel should not get into the calm occasioned by the high land, because it is very difficult to recover the breeze again, and there is always a heavy swell rolling towards the shore, and no anchorage on account of rocks.

A ship bound to Panama during the fine season should adopt the eastern passage between the coast and the Rey Islands, being free from danger with one exception. The water is smooth, and the tide being regular, she can get to the northward much better than in the middle or on the western side of the bay, where there is generally a current and much sea. During the rainy season the direct course up the bay is preferable to the passage between the islands, for the current then is influenced by wind.

From Panama South.—There is always difficulty in going southward or westward from Panama. To clear the bay to the southward mostly requires two days, and this is done either by working along shore against wind and current, or by standing far enough to sea and to the southward to reach our port on the starboard tack. Both of these methods are long and tedious, and it often takes twenty days to reach Guayaquil, while from thence to Panama it takes no more than a week.

From Panama Westward.—A vessel leaving Panama for the westward in the season of the northerly winds, should avoid being delayed by keeping in shore, and should profit by changes of these winds, which would carry her as far as the gulf of Nicoya. When she has passed the Morro Hermoso, she must be ready for Papagayos, heavy breezes, with which she may run through the gulf of Tehuantepec, and if she be bound to a port in the gulf or to Acapulco with these winds she may keep near the coast and close with the land by working. But if she is going West, she should keep out to sea.

The western route on leaving Panama in the rainy season is most tedious, on account of the calms, sudden squalls, and adverse currents, that one has to contend with. There is, moreover, a heavy swell, excessive heat, and abundance of rain. Vessels have not made twenty miles westing in a week, and this only by taking advantage of every favourable puff of wind.

The commanders of coasting vessels differ with regard to the proper route to take. Some say by working to the southward the district of bad weather may be avoided; others prefer working at a modèrate distance from the coast, and this plan is most frequently adopted, because the squalls that are oftener encountered near the land, sometimes admit of standing to the N.W., whilst by keeping out at sea for finer weather this advantage is lost.

The Coast of California.—A vessel from the southward for California direct having run through the S.E. Trades would cross the equator near the meridian of 105°, and then run full and by through N.E. Trades to find the variables about 300 miles East of the Sandwich Islands. Having reached the variables she would make for her port, taking care to get in with the land well to the northward, for as she approaches the coast the wind gets northward and the southerly current runs very strong. Ships from Panama to the North by keeping in shore have required three months for this passage.

From Panama to San Francisco.—The following is a quicker route. On leaving Panama work between South and West while in the S.E. Trade, and if this is strong, go North of the Galapagos; but if weak and variable, pass South of these islands, and always in this first part of the route take care not to make northing until on the meridian of 108° or 110° West, with the view of keeping in the westerly current. Cross the zone of the variables as quickly as possible, for vessels have been carried to the East by the equatorial counter-current. Once having found the N.E. Trade, the southern limit of which is found between 2° and 8° N. lat. according to the time of year, haul the starboard tacks on board, and run full and by through it, and then gain the zone of westerly winds. The ship will then stand for the coast, it being observed that in the season of the N.W. winds (March to November) the current runs South near the land, and therefore it should be made well to the northward of San Francisco. At other times of the year with the wind from S.E. to S.W., the land may be made in the latitude of this port, and in all cases with these winds a vessel may get to the northward without difficulty, even making the land to the southward, for S.W. winds are then frequent. The passage here alluded to is made in thirty-seven to forty days.

From San Francisco to the Sandwich Islands.—A vessel bound to the Sandwich Islands from San Francisco, may generally make her passage direct. If she meets with westerly winds, she will make to the southward, and if they continue she will reach the N.E. Trade, with which she may run West to make the land at a convenient distance East of Hawaii. The S.E. winds sometimes found (principally in June) in the zone of the N.E. Trade, between the parallels of 25° N. and 22° N., are also crossed on the passage from San Francisco to the Sandwich Islands,—a passage which is generally made in sixteen to eighteen days.

From Payta or Guayaquil to San Francisco.—A vessel from Payta or Guayaquil for San Francisco, should stand to the westward, so as to pass South of the Galapagos, and would cross the line as soon as possible between 98° or 100° W., for as soon as she finds the N.E. Trade she should get North as fast as she can, crossing this Trade and reaching the variables in 29° or 30° North. She would then steer direct for San Francisco, making the land a little North of the port. This passage from Payta to San Francisco was made in October by the *Sérieuse* in thirty-four days. Vancouver gives the following directions for ships near the Californian coast.

" The constant northerly winds which prevail near this coast render navigation difficult. A vessel going northward must keep away out to sea until she is well North of the port to which she is going, and then take care to make the land North of it. Still this mode of approaching does not appear to be necessary in December, when we were on the coast. From the bay of San Francisco, as far as Point Conception and even further North, land breezes will enable a vessel to make her passage easily by keeping near the coast. These winds generally come from East to S.E., and a ship can have no difficulty in getting southward with the sea breeze. In fact, during the twenty-four hours the land breeze lasts much longer than the sea breeze, and is often stronger. Besides, a good sailing vessel may still gain something during the day by having a smooth sea with the sea breeze, which although fresh is moderate.

A vessel proceeding from North to South along the West coast of America, will necessarily make her passage according to the place to which she is bound and the monsoon which prevails at different times on the coast.

From San Francisco to Valparaiso.—A ship from San Francisco to Valparaiso should keep to the southward along the coast with the view of gaining the zone of the N.E. Trades as soon as possible, but without passing much East of the meridian of Cape San Lucas, so as not to get out of the strength of the Trade. In this route she will be favoured hy the southerly current of the Californian coast. She would cross the N.E. Trade, taking care not to be carried too far West by the equatorial current and equatorial calms by the time she gains the variables, and from these cross the equator as far East as she can (generally in 118° W. long.) Then crossing the S.E. Trade as soon as she has got into the variables South of the Trades, would run direct for Valparaiso. In this route she may possibly sight Easter Island.

From Acapulco to Panama and Guayaquil (Winter).—A vessel from Acapulco to Panama or Guayaquil during the winter should keep a moderate distance from the coast, so as to be in the Mexican current, and at the same time will have the N.W. monsoon in her favour.

Same Routes (Summer).—But, on the contrary, a ship from Acapulco in the summer should stand out to sea and avoid the Mexican current, as well as the S.E. monsoon, which prevails at that time.

From Acapulco to Valparaiso.— A vessel from Acapulco to Valparaiso should cross the equator in about 100° West, then get as far South as she can without being West of 105°, and so avoid the strength of the equatorial current. It often happens in this route that vessels pass in sight of Easter Island. When she has cleared the S.E Trade, she would make for Valparaiso, taking care that her landfall is South of its parallel, so as to allow for the Humboldt current. The rest depends on the monsoon prevailing on the Mexican coast at the time of being there. The coast may be followed on leaving Acapulco, and the line crossed on the meridian of 87° West, East of the Galapagos; from thence crossing the S.E. Trade, which should be left on the meridian of about 100° West, and make for Valparaiso with the variables.

From Guayaquil to Valparaiso.—In going from Guayaquil to Valparaiso a vessel should keep out at sea, so as to cross Humbolt current before passing the meridian of 92° West, then keep between this and about 102° West, to avoid the equatorial current: then cross the South tropic in 96° West, and make to the southward for the parallel of

Valparaiso. Crossing this, steer for the South American coast, passing close to the northward of Masafuera and Juan Fernandez, making the land South of Valparaiso. This passage is generally made in thirty-seven days.

From Chili or Peru to Pitcairn.—In leaving the Chili or Peru coast for Pitcairn Island, a vessel should stand off the coast and get as soon as possible into the S.E. Trades on the parallel of Noukahiva, or the Sandwich Islands, 20° South, where there is generally a fresh breeze and fine weather. She would then steer West, keeping that parallel, and make Pitcairn Island to the S.W. Then run down to it, taking care not to pass it, and steering a point or two from the direct course, so as to allow for the westerly set of the equatorial current. It is only in the vicinity of this island, and principally in December and January, that N.W. winds are often found.

From Pitcairn Island a ship may steer for the Noukahiva Islands, shaping her course well East of them on account of the westerly current and drift of the Trade. On leaving this archipelago, cross the equator on the meridian of 143° West for the Hawaii Islands, at a distance of sixty miles East of them. Then in crossing the equator the N.E. Trade will be found in 5° or 6° North in winter and spring, or in 9° or 10° North in summer and autumn.

The variable winds near the equator are generally from West, and will serve with the equatorial counter-current. But should these be found from East, great care must be taken against the westerly current, and always cross the equator if possible far East of the meridian of the Sandwich Islands, with the view to make the land of the eastern part of this archipelago. In passing the island of Hawaii, give it a berth of at least forty miles, as within that distance calms continue for several days.

Return Routes from the Sandwich Islands to the Coasts of Chili and Peru, passing Tahiti.—A ship leaving the Sandwich Islands for Chili or Peru, touching at Tahiti, should run to the southward as far as the parallel of the South part of this island, then steer so as to cross the equator if possible East of its meridian or at least on its meridian, for in case when nearing this archipelago the S.E. Trade is found, it will be troublesome to get to the East against current. A vessel therefore should make for the eastern part of these islands. It is always easy to reach them then whichever way the wind may be.

A ship leaving the archipelago of Tahiti for Chili or Peru, should run through the S.E. Trades, keeping full and by, and get on the parallel of 34° or 35° South, where westerly winds will be found, with which she may run to the American coast.

The passage from Tahiti to Pitcairn may sometimes be made rapidly by crossing the southern part of the Pomotou Archipelago, but the greatest caution is required to avoid running on the low islands of these latitudes.

From the Sandwich Islands to the American Coast.—A ship from the Sandwich Islands to the N.W. coast of America should run northward through the N.E. Trade to gain the westerly winds, with which she will easily reach the coast. As she approaches it great care must be taken to keep North of the port to which she is bound, for she will probably find N.W. winds and a strong current setting her South. It is a general rule always to make the land North of the desired port, on account of the prevailing northerly winds hereabouts with southerly current. Although the Sandwich Islands are seated near the northern limit of the Trades, during the winter months South or S.W. winds are found there. In the other seasons fresh easterly winds prevail.

A vessel leaving these islands for Chili or Peru should cross the Trades, keeping clean full without caring to be set West provided that she get South, supposing that she has not to touch at Tahiti. The winds of the northern zone being generally from E.N.E. and N.E., Tahiti may be reached on one tack. When not stopping here it will be useless to try to pass East of it, and a loss of time attended with trouble in hugging the wind, with a strong westerly current at a rate of twenty to forty miles a day. In all cases, unless going to Noukahiva, it will be better, instead of navigating among the islands between the two archipelagoes in a dangerous and difficult navigation, to pass West of Tahiti. Having passed it, we should run southward as far as the parallel of 30° South for the prevailing westerly winds, and then run with them to any port on the coast of Chili and Peru, taking care in approaching the land to be well South of that port.

The late Lieut. Bowers has left the following general remarks in his little work entitled and being useful information to seamen, we insert them here as confirming the conclusions arrived at by the matter which precedes them.

My numerous voyages in these seas having made me familiar with the general and local navigation, a few words on the subject will not be deemed irrelevant or uninteresting. The Trade winds in the Pacific are similar to those in the Atlantic, in the tropic of Cancer blowing between the North and East, and in the tropic of Capricorn between South and East. Near the coast they are confined within the tropics, but as they recede take a wider latitude.

The above, however, may be said only to apply beyond a line one hundred leagues distant from, and parallel to, the coast, in the Southern Pacific; within which line they are subject to many variations. From September (the commencement of spring) to April (autumn) from Chiloe, or latitude 41° S., to Coquimbo, latitude 30° S., the wind is for the most part S.S.W. But from April to September strong monthly gales,—during which these seas will be found any other than pacific,—prevail. From all this it is apparent that the coasting navigation must be regulated in general with reference to the season of the year; subject to which, however, there are many other points, which the navigator will do well to attend to. In general the following remarks, the result of many years' personal experience, may be depended on.

Ships coming from Peru, southward, during the northers, should be careful not to get to the southward of their port. At any other season of the year Juan Fernandez, or Mass a Fuera, may be made with safety, both being high and bold. Those falling to the northward of their destination during the summer months, when the S.S.W. wind prevails, at a distance of thirty or forty leagues off shore, need not tack, as the wind, drawing to the westward as they stand in, will be found to favour them so as to lay up E.S.E., which with the variation 17° or 18° easterly, will enable them to "claw" to the southward. On a passage from Arica to Valparaiso, I once beat a much faster sailing vessel than my own by four days. Finding ourselves, as we stood in, to leeward of our latitude, and only looking up E.N.E., my companion tacked, while I continued my course, and availing myself of my local knowledge of the coast, reached my port.

The passage from Lima to the intermediate ports of Cabija, Arica, Islay, and others adjacent, may be made to advantage in a good sailing craft, by keeping about thirty leagues off shore, and tacking twice only in the twenty-four hours; standing off all night, and in all day; the wind generally veering two or more points with the sun. When once in the latitude of your port, stand boldly in as before directed, the wind invariably inclining westerly as you draw in, so as not unfrequently, during the first two or three hours of the sea breeze, to bring you up to S.E. The exception to this rule is in September and the three following months; when it will be necessary to keep in shore, being assured in the night, during this interval, of a fine land breeze. The coaster should contrive to be close in by eight or nine in the evening, and if from Islay, or Arica, to Cobija, or Iquique, should steer off due S.W. This places him in the best position for availing himself of the sea breeze the following morning, which commences at S.S.W., and goes gradually round as the sun gets up to S.S.E., generally dying away after sunset, when, after a short interval of calm, the land wind from East sets in for the night.

The whole of the coast from Cobija to Quilca being perfectly bold, with a clean sandy bottom close in, offering tolerable anchorage every two or three leagues under the different points, may be approached without apprehension; albeit, there is constantly a heavy swell from the S.W., and a lee current inclining off shore at an angle of about two points. In the vicinity of Quilca it runs due W.b.N., at the rate of one mile and a quarter per hour. Until recently, this port has been laid down forty miles too far to the westward, an error which has often occasioned much delay and inconvenience.

Lying at this place once, when H.M.S. *Fly* was expected, I observed her in the offing steering wide of the port with studding sails set on both sides. By firing several guns with a double charge of powder and wadding, I succeeded in drawing her attention, when, instantly hauling up, she was enabled by means of my night signals to fetch in. On pulling on board to pilot her to her anchorage, Captain Martin, fully sensible of the great inconvenience and loss of time I had prevented, thanked me very cordially. Since this period, however, excellent and correct charts, copied from an accurate survey made of the coast by the officers of the French ship *Clorinde*, Baron Macaux, have been published, which all masters of ships navigating this coast would do well to procure.

At Islay, vessels may anchor in ten, twelve, or fourteen fathoms, close into the mole, and steady with a hawser to the small black rock that will be found there; even when the swell sets in, vessels may ride with little strain. The country craft, however, frequently part their rotten cables, on which occasion they put to sea. At this place a scanty supply of water brought from a distance of four miles, is turned with much ingenuity to the different parts of the town and mole, by means of a sort of hollow tile, placed in a manner similar to those in the roof a house. At Arica ships should never anchor in less than ten fathoms, on account of the heavy swell, which in shallower water would cause them to strike.

At all seasons of the year, on leaving Peru for Chili, it should be the practice in general—as in crossing the Trades in the Atlantic—to steer sufficiently off the wind to allow the fore top-mast studding-sail to draw; or, if blowing hard, with a rough sea, as is frequently the case in this miscalled Pacific, sufficiently free to leave a strait wake. This, at a hundred leagues from the land, at which distance, as before remarked, the regular Trade blows and the wind hangs well East, will soon carry you into the variables, the most prevalent of which are westerly. Numerous infallible tokens give timely notice to the seaman of his approach to the land. At thirty leagues distance the albatross, and next the cape hen (a large black bird with a short tail and stunted wings) are seen; then a heavy swell from the S.W., with the seaweed, may be regarded as never-failing indication. In making the passages, though for years I never hove a log or took above three observations, I was never deceived in my reckoning.

From Cape Horn, or the southern parts of Chili, in the winter, with North and N.W. gales, I should recommend to stand to the westward by day, and put about on the leeboard tack by night; for the same reasons that, it may be remembered, I have in a former part of this work recommended the reverse in the northern hemisphere; the wind in the southern generally shifting in a sudden squall from N.W. to S.W. or West, and blowing so furiously as to endanger any vessel taken aback, which would be the case if on the starboard tack. This, it is but too probable, was the fate of the Anglo-Spanish privateer *Valdez*, (previously Algerine,) Captain Mitchell, which fitted out in Rio, in 1824, under the auspices of the Spanish Ambassador at that port, and last seen in a high southern latitude, where she had captured a large Genoese ship, which she sent into Chiloe, was never more heard of. In this ill-fated vessel perished most of the Peruvian cavalry officers, among others the colonel, Count San Miguel, taken in a transport from Ylo, after the defeat of Santa Cruz.

The passage round Cape Horn has lost all those terrors inspired by the ill success and inexperience of Anson and the earliest navigators. But, although become an every day affair, the mode of passing it is still a matter of dispute among navigators, some insisting that the in-shore, others the off-shore, passage is the best. For my own part I am for the latter. Without doubt good passages have been performed in-shore, but a much greater number of severe ones; off-shore you avoid a strong N.E. current, running from or close round the cape, and extending past the eastern Falklands; for this I usually allowed a mile and a half per hour, and found it not a bit too much. Moreover. the weather in general is clearer and the sea more regular; I should therefore recommend to pass wide of the Falklands, well to the southward of the cape, and not to haul to the northward until in the 38th degree of longitude; by attending to this, one is enabled to stand well on in the event of N.N.W. winds.

In the year 1820, a fine little brig, belonging to Weymouth, commanded by an individual whose knowledge of chronometers or lunars extended no further than their names, attempted to double the cape for Valparaiso. Trusting to what he thought a good dead reckoning, which placed him on the chart in the 80th degree of longitude, he shaped his course to the northward accordingly, hauled in for what he conjectured to be the land about Conception, killed the remainder of his live stock, and treated his passengers in the true style of "Fair wind and fair allowance." His surprise and mortification may be easily imagined, on finding himself, instead of being within a few days' sail of his destined port at the entrance of the River Plate.

We conclude with the following brief Table of Passages, which we hope to extend in another edition.

Passages.	*Days.*	*Months.*
Acapulco to Panama	31	December.
,, Valparaiso	42	May and June.
Arica to Callao	6	January.
Bass Strait to Tonga	31	February and March.
Caldera to Cobija	5	January.
Callao to Sandwich Islands	37	July and August.
,, Nouka Hiva	23	March and April.
,, San Francisco	50	September, October, November.
,, Tahiti	29	
,, Valparaiso	25	February and March.
Chilo to Talcahuana	3	December.
Chinchas to Callao	2	February.
,, Valparaiso	19	August.
Cobija to Arica	3	January.
,, Callao	7	October.
,, Iquique	2	January.
Coquimbo to Caldera	3	January.
,, Valparaiso	4	November.
Guam to Manila	22	October.
Guayaquil to Callao	3	
,, Nouka Hiva	23	April.
Hawaii to Guam	25	September.
,, Petropaulowski	25	September and October.
,, San Francisco	25	June and July.
,, Tahiti	22	July.
Hobart Town to Tahiti	50	March and April.
Ipula to Tahiti	52	May and June.
Iquique to Arica	2	January.

Passages.	*Days.*	*Months.*
Iquique to Islay	3	February.
Islay to Chinchas	5	February.
Macao to Hawaii	50	May and June.
Manila to Tahiti	116	December to April.
Along the equator as far as 163° W. should have taken the northerly route.		
Mazatlan to Acapulco	10	December.
,, San Blas	3	May.
Nouka Hiva to Tahiti	8	September.
,, Sandwich Ids.	14	July.
Panama to Guayaquil	19	February.
,, San Francisco	37	
Petropaulowski to S. Francisco.	27	September.
Pitcairn to Sandwich Islands.	20	May.
San Blas to Acapulco	9	May.
San Francisco to Sandwich Is.	16	November.
,, Mazatlan	14	November.
,, Nouka Hiva.	34	February and March.
,, Tahiti	31	May and August.
,, Valparaiso	63	October.
San Jose to Callao	42	March and April.
Sydney to Pitcairn	39	March and April.
,, Tahiti	42	January, February, and August.
Tahiti to Sandwich Islands	19	April and June.
,, Nouka Hiva	30	April and May, northern route by tropic of Capricorn.
,, New Zealand	28	March and April.
,, Sydney	26	November, April, and May.
,, Tonga	13	November.
,, Valparaiso	36	December, January, Feb., May, June, July, and August.
Talcahuana to Valparaiso	21	
Tonga to Tahiti	49	March and April, southern route by tropic of Capricorn.
,, Sydney	26	May.
Valparaiso to Callao	10	
,, Chiloe	19	November.
,, Cobija	8	January.
,, Coquimbo	21	
,, Guayaquil	17	April.
,, Nouka Hiva	41	May.
,, Puna	15	April.
,, San Francisco	62	August, September, October.
,, Tahiti	41	
,, Talcahuana	6	December.

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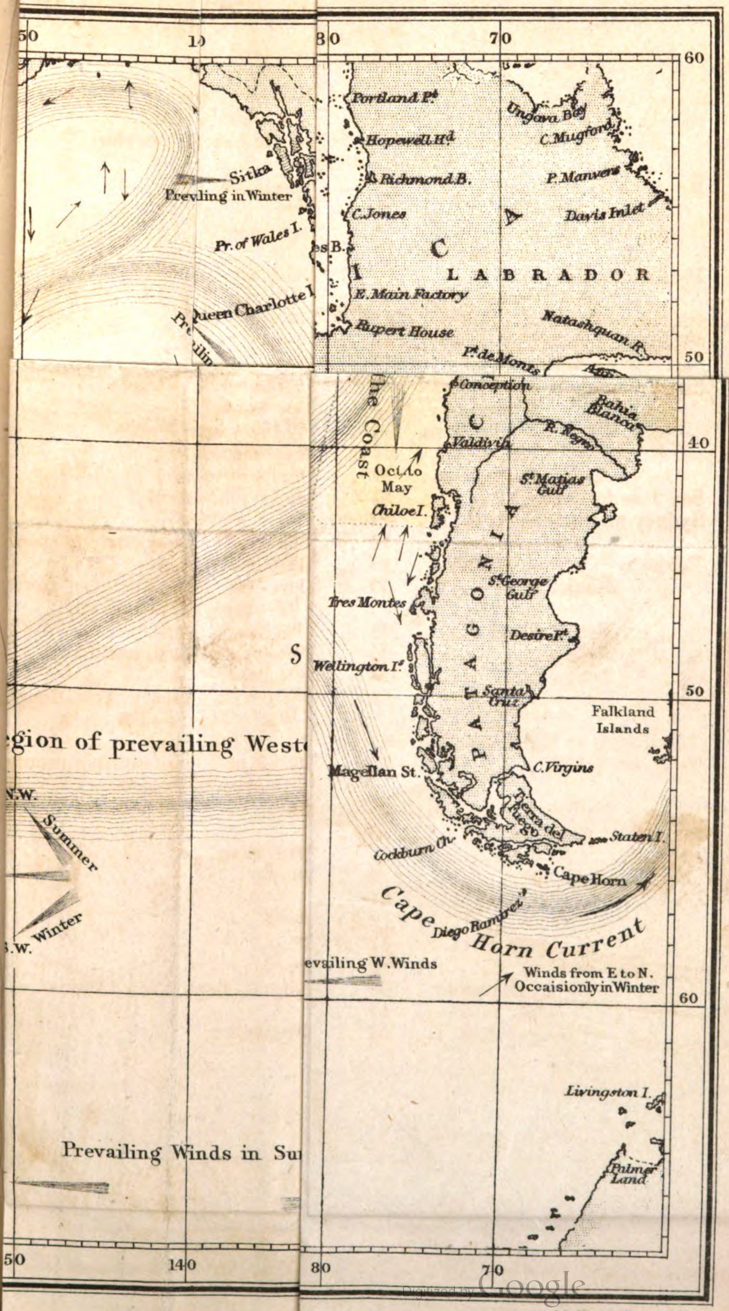

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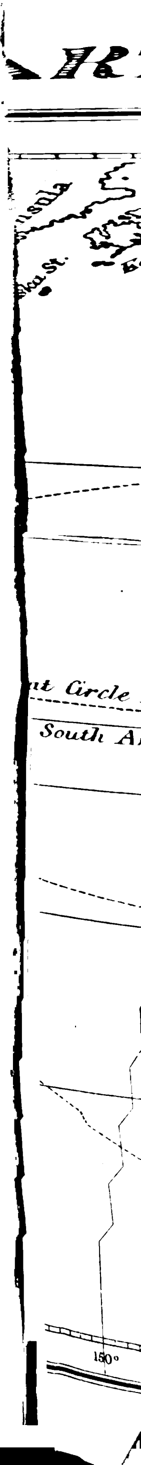
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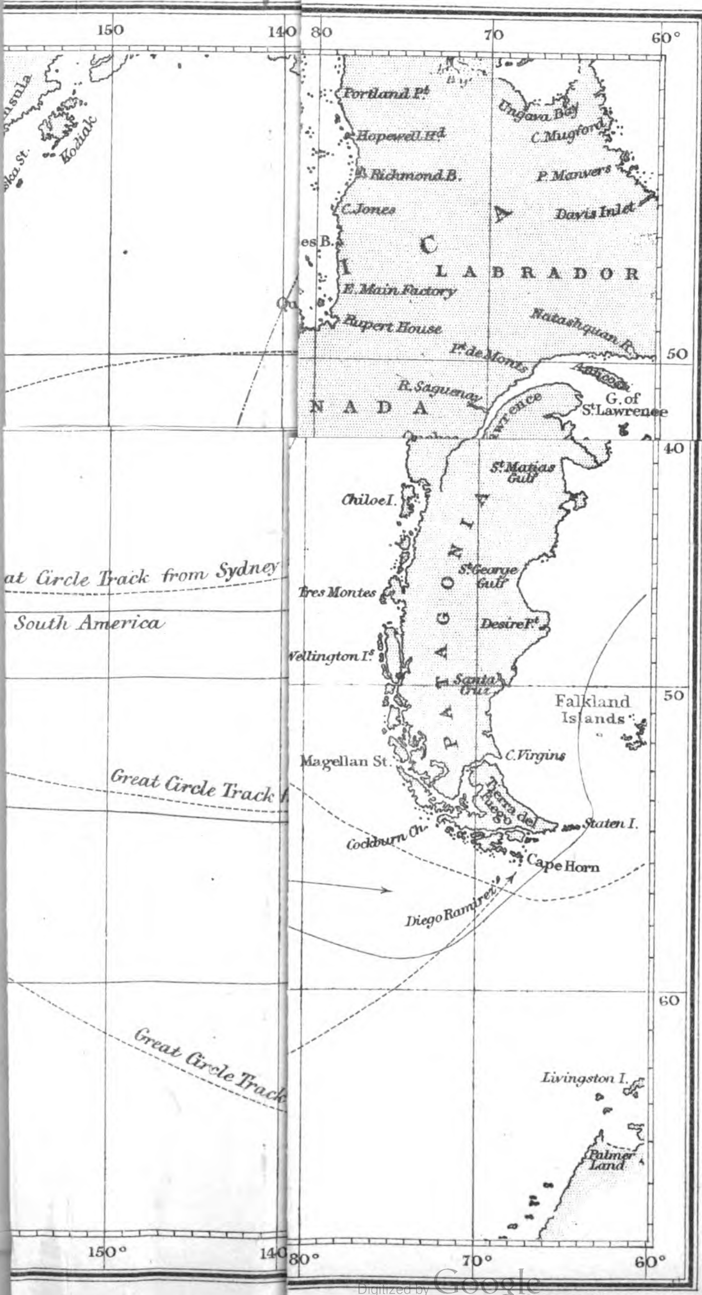

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